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DRAFT

SITE BACKGROUND SUMMARY
FOR THE
SOUTH TACOMA FIELD SUPERFUND SITE

April 1990
Revision 0

Submitted to:

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NOTICE

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LIST OF ACRONYMS USED IN THIS DOCUMENT

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BN	Burlington Northern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (1980)
CLP	Contract Laboratory Program
CWA	Clean Water Act (also FWPCA)
DOE	Washington State Department of Ecology
DOI	Department of Interior
DW	Dangerous Wastes
E & E	Ecology and Environment
EHW	Extremely Hazardous Wastes
EIS	Environmental Impact Statement
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
GAC	Granular Activated Carbon
MCLs	Maximum Contaminant Level
MCLGs	Maximum Contaminant Level Goals
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
PAHs	Poly Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
ppm	Parts Per Million
PRP	Potentially Responsible Party
QA	Quality Assurance

LIST OF ACRONYMS USED IN THIS DOCUMENT
Continued

QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendment and Reauthorization Act (1986)
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SFD	Single Family Dwelling
SMCLs	Secondary Maximum Contaminant Levels
STF	South Tacoma Field Superfund Site
TBCs	To Be Considered Concentrations
TCE	Trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIP	Tacoma Industrial Properties
TPCHD	Tacoma-Pierce County Health Department
TTLC	Total Threshold Limit Concentrations
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

1.1 OBJECTIVE OF THE REPORT

This document presents the results of the preliminary round of scoping activities conducted for the South Tacoma Field Superfund site. Scoping is a process used to assess the extent of the information available for a site regarding the chemicals that may be present. Based on this information, the potential health and environmental impacts posed by the actual or suspected contamination present are estimated and the additional data needed to adequately assess the risks and implement necessary remedial actions are identified. It is the objective of the scoping process to identify the types of decisions that need to be made and the quality and quantities of data necessary for making them so that efficient data collection activities are designed.

1.2 PROJECT BACKGROUND

In 1981, the South Tacoma Channel was designated a high priority under Superfund because one of the wells in the City of Tacoma's municipal water supply system was found to contain elevated concentrations of chlorinated solvents. The South Tacoma Field (STF) was included in this designation because of its potential as a recharge area and because of suspected on-site contamination. In an effort to locate the source of this contamination, a study of the industries in the STF area was undertaken. Although the STF site was determined not to be the contributor to the contamination in the City's supply well, other potential environmental contamination was identified.

This report is based on information collected as part of the State Department of Ecology's (EPA) monitoring program as well as information from a number of different reports prepared over the last eight years. Some of the studies were conducted to gain information about specific pieces of property located within the boundaries of the site. These studies were authorized by persons considering the purchase of the land. Other studies were conducted by property owners to ascertain the existence and the extent of any contamination on their lands.

EPA is now consolidating the information from these and other sources and devising an overall strategy for the assessment and remediation of the STF site. This background document represents the first step toward this goal. It presents a summary of the information available regarding the types of activities that took place in various areas of the site and the practices and substances that may have been used there. Additionally, it presents a summary of the chemicals present at the site as derived from the examination of the monitoring information identified to date. Lastly, it preliminarily identifies potential human health and environmental impacts that may result from the presence of these chemicals.

1.3 REPORT ORGANIZATION

The remainder of this report is organized into eight sections. The first section, Section 2.0, discusses the location of the site and describes the persons and the activities characteristic of the surrounding area.

The next section, Section 3.0, describes the physical, biological, and cultural features of the site. This includes discussions of site geology, hydrology, and meteorology, as well as discussions of some of the flora and fauna present at the site.

Section 4.0 reviews the information available regarding the history of the site. This review discusses the past uses of the properties and describes common practices (storage, use, and disposal of chemicals) that occurred at various locations within the site boundary.

Section 5.0 identifies the current uses of the STF properties and some of the current chemical handling practices. This section also presents information on the current status of site access and security.

Section 6.0 summarizes the previous investigations conducted at the property and consolidates this information into an overall picture of the chemicals present at the site.

Section 7.0 identifies the potential pathways by which humans and other animals or plants might be exposed to chemicals from the site. The potential human health and environmental impacts of these exposures are preliminarily discussed.

Section 8.0 contains a preliminary identification of the potential Applicable or Relevant and Appropriate Requirements (ARARs) for the STF site.

Section 9.0 discusses several remedial alternatives preliminarily identified for consideration at the STF site.

2.0 SITE LOCATION

This section presents information about the general location of the STF site and some of the pertinent features of the surrounding area. Additionally, the populations living in the area are described along with the locations of facilities such as parks, schools, and hospitals that they may frequent.

2.1 SITE LOCATION AND FEATURES

The South Tacoma Field Superfund site is located in the southwestern section of the City of Tacoma (see Figure 2-1) just over 1 mile west of Interstate Highway 5 and approximately three and one-half miles north of McChord Air Force Base. The extreme southern portion of the site abuts South 56th Street while South 36th Street determines the northern boundary of the site. Manitou Way and Tyler Street bound the site on the west. On the east, the site is bounded by the Burlington Northern Railroad right-of-way.

The STF site is found on the following Pierce County Tax Assessor's plat maps:

- NE24 T20N R2E
- NE13 T20N R2E
- SE13 T20N R2E

Specifically, the site occupies approximately 300 acres of land in the NE 1/4 of Section 24 and E 1/2 of Section 13 of Township 20 North, Range 2 East, Pierce County, Washington. This land is zoned for heavy (M-2) and light (M-1) industrial uses.

The area within one mile of the STF site is zoned for almost every conceivable use. A summary of the different uses for which the area surrounding (within a one mile limit) the STF site is zoned as follows:

Residential

R-2	Single Family Dwellings only (SFD)
R-2-T	Residential, Commercial, and Transitional (Res. & Ofc)
R-2SRD	Special Review District for SFD
R-2-PRD	Planned Residential District for SFD

R-2-TM	Medical and Transitional for SFD areas
R-3	Two- and Three-Family Dwelling Units
R-3-PRD	Planned Residential District for Two- and Three-Family Dwelling Units
R-4	Multiple Family Dwelling Units
R-4-L	Low Density Multi-Family Dwelling Unit
R-4-PRD	Planned Residential District for Multi-Family
R-4-L-PRD	Planned Residential District for Low Density Multi-Family
R-4-TM	Transitional and Medical for Low Density Multi-Family Areas
R-5	High Density Multi-Family Dwelling Unit
R-5-TM	High Density Transitional and Medical for High Density Multi-Family

Commercial/Industrial

C-1	Commercial District - Neighborhood Scale
C-2	Commercial District - Area Wide Significance
CPN	Planned Shopping Center District - Neighborhood
CPC	Planned Shopping Center District - Area Wide
M-1	Light Industry
M-2	Heavy Industry

The Tacoma Channel was formed by melt water originating from a glacial lake located in the Puyallup River valley and is four miles long. The channel traverses parts of the City of Tacoma, and underlies the South Tacoma Field site. The STF site lies on the floor of this erosional channel and is as much as 150 feet lower than the uplands that surround the site.

No creeks, streams, or rivers pass through the STF site. However, ephemeral surface water may be found below the bluffs in the western area of the site. Approximately one and one-quarter miles directly south of the site lie the headwaters of Flett Creek. Flett Creek drains into Chambers Creek at a point

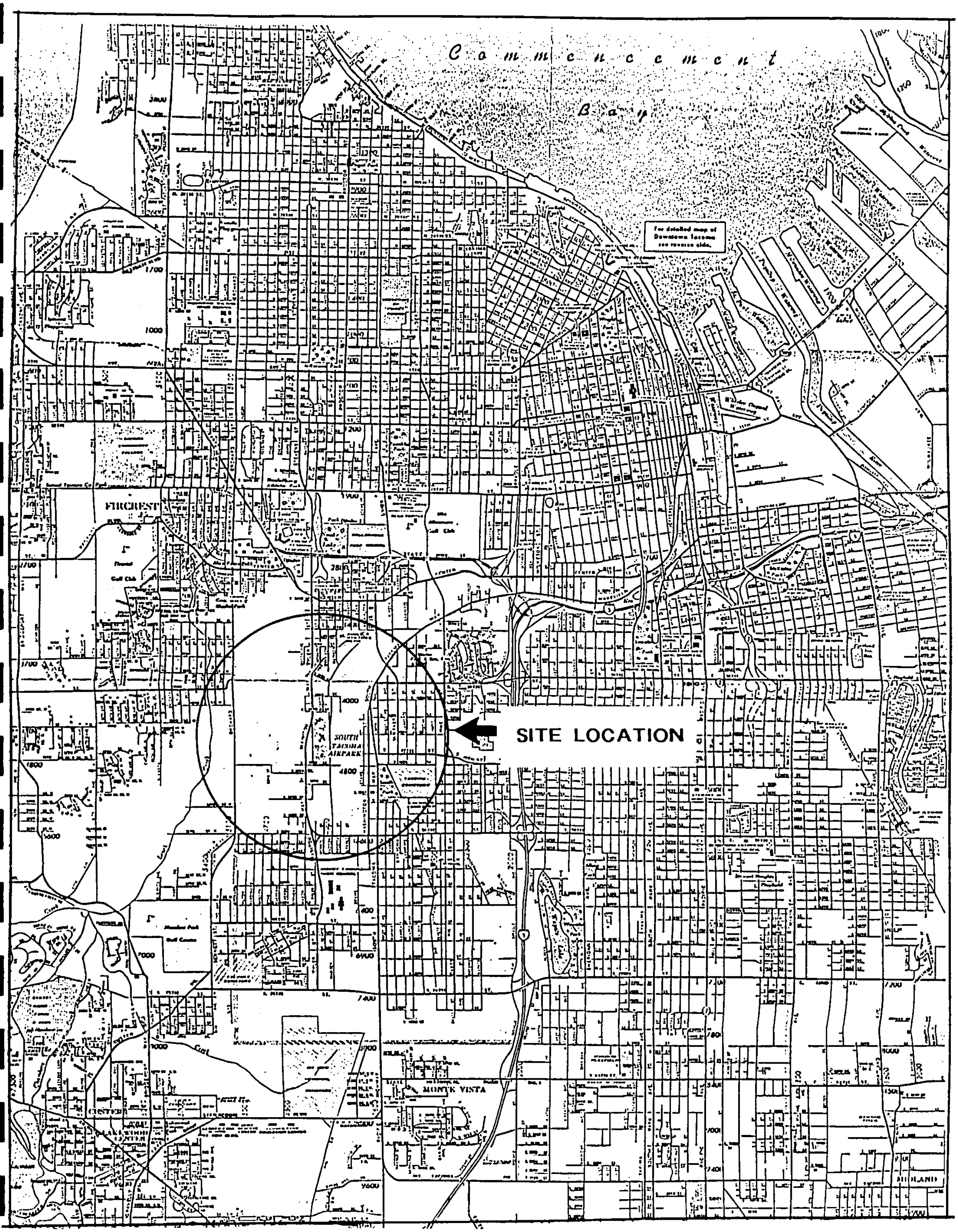


FIGURE 2-1

SITE LOCATION MAP

roughly one and three-quarters miles from the site in a southwesterly direction. Subsequent to the confluence of Flett Creek and Chambers Creek, Chambers Creek flows into Puget Sound. Leach Creek flows in a southerly direction parallel to the western site boundaries. Leach Creek is the closest creek to the site lying approximately 0.6 miles directly west.

2.2 SITE DEMOGRAPHICS

Residential development surrounds the property on all sides except the west. Limited residential development is found west of Manitou Way. According to 1980 census data, 23,997 people lived within a one mile radius of the STF site. Approximately twenty-five percent of the population were under 16 years of age, fifty-five percent were between 16 and 55, and twenty percent were 55 years or older. By the year 1995, the population around the site is expected to increase to about 28,000 with the ratio of ages remaining approximately the same.

Younger members of the population are likely to attend one of the four kindergartens or thirteen schools located in the area (within one mile of the site); two of these schools are located within one to three blocks of the site boundaries. The more elderly members of the populations may be concentrated in one of the nursing homes located in the vicinity. Six nursing homes are located within one mile of the site; one of them is located within two blocks of the western site boundary.

A number of parks and playgrounds exist in the area which residents and visitors may frequent. As an example, the South End Recreational Area, is located just one block south of the STF site. Two hospitals are located about one mile north of the site.

3.0 SITE DESCRIPTION

This section describes the physical, biologic, and cultural characteristics of the STF site. Section 3.1 describes the general physical features of the site and discusses the significance of these features with relation to potential contaminant migration. Section 3.2 presents information about the biological characteristics of the site, namely, the flora and fauna of the area and the woodland and wetland habitats in which they exist. Finally, Section 3.3, provides information about potential cultural features of the site. Communications with the Washington State Office of Archaeology and Historic Preservation and the Department of the Interior are recounted.

3.1 PHYSICAL CHARACTERISTICS

Physical characteristics covered in this section include: the general geological characteristics of the area; the characteristics of the soils underneath the STF site; the hydrogeologic features of the area including the locations of nearby public and private drinking water, process, and monitoring wells; and lastly the meteorologic characteristics of the region.

3.1.1 Geology

The discussion of the geology in the vicinity of the STF site is divided into two major topics: the general geologic features of the area, and the hydro-stratigraphic aspects of those features.

General Geologic Setting. Near-surface geology of the general area in which the STF site is situated consists exclusively of glacial deposits. These deposits are the products of the Pleistocene glacial epoch, deposited during the Vashon stade (phase) of the Fraser glaciation period. The bulk of these deposits consists of two general types of sedimentary units: glacial till or outwash.

Glacial till consists of intimately mixed, disordered, poorly sorted sediments whose particles range in size from clay to boulders. Till represents material that was scraped or ground up by glacial movement and transported with the glacier. It is gradually deposited along the bottom, sides and front of the glacier during stable periods, and rapidly during melting and retreat of the glacier. Till, initially incorporated into the glacial snow and ice by the advancing glacier, literally falls out of the glacier as the ice melts. The resulting texture is a random mixture of larger particle sizes infiltrated by the fine-grained material. The material that fills the spaces between the cobbles and boulders in the till, known as matrix, generally consists of sand, silt, and clay, commonly with a high content of clay. Typically, this matrix material is nearly impermeable.

Outwash material is deposited by glacial meltwater streams. It is largely the water-laid equivalent of till. The primary difference is textural, in that stream action winnows the till, transporting the finer material downstream, and, to the extent hydrodynamically possible, sorts and redeposits the boulders, cobbles and gravel material into more ordered or "organized" textures. This sorting process results in layered sedimentary units that consist of more similar particle sizes, that are porous, permeable, and not filled with matrix material.

The bulk of the area in the vicinity of the STF site is underlain by impermeable to poorly permeable till, which is bisected by the more permeable outwash deposits of the Tacoma Channel. The Tacoma Channel was eroded into the till by melt water originating from a glacial lake located in the Puyallup River valley. The channel traverses parts of the City of Tacoma, and underlies the South Tacoma Field site. To the south of the channel, the outwash deposits widen into a broad outwash plain.

Hydro-stratigraphy. The area has been studied by Brown and Caldwell (1985), and Remedial Technologies, Inc. (1987), from which most of the following discussion has been derived. These investigators have subdivided the local stratigraphic section into five major hydrogeologic units.

Layer A, consisting predominantly of permeable outwash, is defined stratigraphically as all units above the interglacial Kitsap Formation. In this area, Layer A is an unconfined surface aquifer. In the vicinity of the South Tacoma Field site, the only surficial unit within Layer A is the Steilacoom Gravels. These gravels extend to a depth of 99 feet in the area of the South Tacoma Field, and are estimated to be no thicker than 150 feet throughout their extent. The permeability of these units is estimated to be 24,000 gpd/ft2 (1.1 cm/sec). This is an extremely high permeability. These gravels probably serve as a substantial recharge area for Layer A. At the surface, the Steilacoom Gravels are bordered by the Vashon Till and the Vashon Advance Outwash, but neither of these units are saturated in this area. Some disagreement exists in the interpretation of certain of the lower units of Layer A. These units (Remedial Technologies, Inc., 1987) and are either nonglacial sediments or older glacial sediments. Their thicknesses range from 5 to 20 feet.

Layer B, is stratigraphically equivalent to the Kitsap Formation, and consists of, primarily, silt and clay, and is considered to be an important regional aquitard. The permeability of Layer B is estimated to be 10 to 100 gpd/ft2 (a maximum of 5 X 10^{-3} cm/sec). Layer B is thought to have been deposited in a low energy fluvial environment during an interglacial period.

Layer C, is probably stratigraphically equivalent to the Salmon Springs Drift. The unit is an aquifer, probably outwash, consisting largely of sand and gravel. Its permeability is estimated to range from 30 to 300 gpd/ft2 (0.01 cm/sec). The potentiometric surface of Layer C is only slightly lower than the potentiometric surface of Layer A.

Layer D is probably stratigraphically equivalent to the Puyallup Formation, and is considered to be an aquitard. Its permeability is estimated to range from 3 to 30 gpd/ft2 (1 X 10^{-3} cm/sec). It is composed of clay, silt and sand, and is interpreted to have been deposited in a low energy fluvial environment during an interglacial period.

Issues of Geologic Significance. Remedial Technologies, Inc. (1987) present data that suggest that the Steilacoom Gravels aquifer of Layer A may be hydraulically connected with and recharge to Layer C (the Salmon Springs Drift). This is significant as Layer A underlies the South Tacoma Field site and the Steilacoom Gravels specifically underlie the City of Tacoma Landfill. These gravels are being used by the City of Tacoma for a municipal water supply. Should contamination become present within the Steilacoom Gravels of Layer A, contamination could spread into both the municipal water supply and Tacoma's alternative aquifer, Layer C.

3.1.2 Soils

First, a brief and general discussion of the soils in the vicinity of the South Tacoma Field Superfund site is presented followed by a discussion of those soils found to occur at the site. The soils underlying the STF site have not been mapped and, therefore, are not included in the soil survey of Pierce County prepared by the United States Department of Agriculture (U.S.D.A. 1979). Soils immediately to the west of the STF site belong to the Alderwood-Everett association while those to the south pertain to the Spanaway Association. Of the various associations into which soils have been grouped in Pierce County, soils of the Spanaway association should most closely resemble the soils found at the site.

Soils of the Spanaway series comprise 67 percent of the Spanaway association. Spanaway series soils formed in glacial outwash that is mixed in the upper part with volcanic ash. In a typical soil horizon of the Spanaway series, the upper 18 inches consists of gravelly sandy loam material. From 18 inches to 60 inches or more the soils are composed of gravelly sands. The original upper soil horizon at the STF site contains dark brown to black sand with some silt and organic matter. The next native soil horizon, immediately underlying the upper horizon, generally consists of sandy materials with gravel throughout. The sandy material is consist with the type of sediments found in the Spanaway series.

Past soil explorations at the site have shown that essentially all of the site is covered by fill material. The depth of the fill material increases in thickness as one proceeds from east to west across the site. Along the eastern boundary of the site the fill material appears to be less than one foot in depth. As we move toward the western boundary, from the eastern boundary, the fill material gradually increases in depth until it is approximately 15 feet thick along the base of the bluffs that mark the western site boundary. The western portion of the study area has an average fill depth of approximately one to three feet.

The fill material is highly variable in composition and is related to the types of manufacturing and dumping activities that were prevalent at any point in time. The most common fill material was cinder which may contain materials such as slag, brick, glass, and metal. Pieces of scrap metal are evident throughout the site and may complicate the interpretation of results from any magnetometer surveys conducted to locate buried tanks, barrels, and drums. Slag materials are also in evidence in large areas of the site. These slag materials, in fact, predominate in certain areas. In particular, along the western portion of the Amsted property it is possible to observe a slag wall that is several feet thick. This slag wall turns Madison street into a virtual elevation divide between the western and eastern portions of the site at the southern end. This elevation divide is evident only at the southern end of the site.

Lime and sulfur material has been found along the extreme southern portion of the site and might be considered fill material even though the extent of this fill is relatively local and the quantities, compared to the cinder fill, relatively small. The lime and sulfur deposits are found directly to the east after turning onto Proctor Street from 56th Street. The depth of lime in the largest of the lime pits extends to approximately eight feet. However, the total quantity of lime in both lime pits is quite small and is estimated at roughly 3200 yd^3.

Soil descriptions exist from the wells, soil borings, and test pits that have been constructed at this site. In this report, the soils found in selected excavations will be described to provide more specific detail into the type of material that underlies the STF site. Excavations throughout the site have been randomly selected and the associated soil descriptions have been obtained. The selections of excavations may not be most representative of the predominant materials found at the site, but will provide additional detail into the types of materials that might be encountered when proceeding with a sampling plan or remedial activities. The descriptions are presented beginning with the excavations at the southern part of the site and proceed to the northern areas.

As mentioned, the initial excavations selected are at the southern end of the site. One well (CBS-05) and one test pit (#12) were selected. The well is located just south of the southern gate to the property and is not situated on the STF site. The test pit is to the east of Proctor Road after turning onto Proctor from 56th street.

Descriptions for the soils from the well (CBS-05) are available to a depth of approximately 28 feet. The upper two and one-half feet consists of brown, fine-grained sand with some silt and clay present. Below this upper two and one-half foot horizon, down to a depth of 28 feet, the subsurface soils are essentially sands. At a depth of 7 feet a trace of gravel was found while at a depth of 12 feet traces of silt and clay were observed. At a depth of 28 feet, the packing density of the sand decreased and became more loose than had been previously observed in the overlying horizons.

In the test pit, cinders were noted from the surface to a depth of ten feet. The cinders in the upper eight feet of the pit were associated with sand and, occasionally, pieces of brick. Those cinders from eight to 10 feet in depth were associated with some silty sand. From 10 to 11 feet fine to medium sands comprised the excavated materials.

As we proceed from south to north at the STF site another well (CBS-04) and test pit (TP-1) were selected to provide further details into site-specific soils. The test pit is situated on the Amsted property and the well is located southeast of the southern wall of the former Iron Foundry building.

Descriptions of the soils from the well logs pertaining to CBS-04 are available to a depth of approximately 25 feet. The upper horizons at CBS-04 are silty clay with some fine sand to silty sand down to a depth of less than 3 feet. Below 3 feet the soils are brown, fine- to medium-grained sand. Silt and gravel occur at approximately 11 feet while the gravel content increases between 17 and 22 feet. Traces of silt and gravel are also found around 25 feet.

In the test pit (TP-1) angular slag up to 18 inches in diameter was found to a depth of 5 feet. Between 5 and 6 feet the slag material formed a solid boundary indicating that, perhaps, molten material had been placed on the site. The slag material continued down from the 6 foot level to the 8 foot level. Light brown sand with silt was found from eight feet to fourteen feet in depth. The pit was terminated at fourteen feet.

In the middle portion of the site no test pits were available for evaluation purposes. Wells in this general area (e.g., CBS-03, CBS-06, and CBS-13) typically contained brown, fine- to medium-grained sands to depths of over 25 feet. Small gravel and silt lenses were encountered with depth at these wells. Of particular note was the layer of peat found at CBS-06 at a depth of approximately six feet.

At the northern end of the STF site, on 13 acres immediately south of the Tacoma City Light property, several trenches were dug by the Tacoma-Pierce County Health Department (TPCHD). The results of the excavations at these trenches will be summarized along with the well log from CBS-01. The well log reports, basically, sand to depths of 25 feet. The logging of the well was discontinued at the 25 foot mark.

Soil profiles from sixteen trenches, along with several other excavations, are presented in the TPCHD report. The results of these excavations are summarized to provide an idea of the soils and types of debris found to depths of from 5 to 7 feet. The excavations conducted by TPCHD usually terminated at depths of from 5 to 7 feet. The soil types found in the excavations almost exclusively consisted of sands, gravel and cobbles.

A quantity of debris was uncovered in these excavations. A partial listing of the types of debris encountered is included here: scrap iron, wood timbers, concrete blocks, iron slag, concrete slabs, bulkhead, steel pipes, copper wire, and railcar track. Chemicals were also discernible in the excavations. Charcoal was fairly abundant. Hydrocarbons that were observed included oil and tar covered debris.

Issues of Significance. In summary, the site is underlain by sandy and gravelly materials to depths greater than 25 feet. These sands and gravels are consistent with the geologic description and with the soils that have been mapped to the south of the site (Spanaway series soils). The well logs and soil series descriptions do not reveal, however, the magnitude of the dumping of fill material that has occurred on-site. These fill materials extend in depth from less than 1 foot on the eastern portion of the site to over 15 feet along the western site boundaries. The soils associated with the fill materials are generally sandy and gravelly much like the original site soils. The fill materials, however, contain cinders, slag, and other debris such as described in the preceding paragraphs.

3.1.3 Hydrology

A lake was, at one time, located in the southwestern portion of the STF site but has been almost entirely filled with man-made refuse and fill dirt hauled in from . Some areas of standing surface water and wetlands are still found on-site.

The aquifer associated with the STF site is regional in extent and includes a wide area in the Tacoma vicinity. The aquifer is the same aquifer underlying the Tacoma Landfill and being used by the City of Tacoma for a municipal water supply. The study area is a recharge zone for the regional aquifer. Significant monthly variation in the phreatic surface are revealed and are believed to be due to variations in precipitation as well as in the operation of the City of Tacoma wells.

The north end of the STF site was studied by the Tacoma-Pierce County Health Department (1986). The groundwater flow direction in the area of the B/N site is complex and depends upon the number of surrounding City wells in use. Also variation in local precipitation causes significant fluctuations in the elevation of the groundwater table.

Detail of the gradients and flow directions are provided by SAIC (1989). This source reports that the water table under the South Tacoma Channel is typically 10 to 40 feet below land surface. The water table gradients in the area of the South Tacoma Channel are very flat and flow directions change during the seasons. Data from March 1987 (the high water season) revealed a groundwater ridge (recharge area) oriented north-south with flow to the north. The flow was generally to the west during the dry season (data from October 1987). The report concluded that "the flow directions change seasonally about 90 degrees in the central and south part of the of the site and nearly 180 degrees in the north part."

Monitoring Well Descriptions. Thirteen groundwater monitoring wells, known as CBS-1 through CBS-13 were constructed at the site by Black and Veatch for the U.S. EPA in 1983. Four of the wells (CBS-02, CBS-06, CBS-12, CBS-13 were plugged by vandals (Remedial Technologies, Inc. 1987). However, a sounding of the wells conducted in April, 1990 revealed that only CBS-13 was plugged to the extent that the water level in the well could not be determined. Additional groundwater monitoring wells were drilled by Kennedy/Jenks/Chilton in the area of the former iron foundry. Also, to the west, of the site are several Tacoma Landfill wells (TL-1, 4, 9, 10, 11, 12, 13, 14, 15, 16, and 17).

Information on these wells in the vicinity of the site is given in Table 3-1.

Public and Private Drinking Water Wells. The well logs at the Tacoma-Pierce County Health Department were researched to determine all wells within 1 mile of the site boundaries. Also the Kennedy/Jenks/Chilton (1988) in their report for Tacoma Industrial Properties (TIP) Management, report on wells in the area of the site. Furthermore, well descriptions and locations were obtained from the Washington Department of Ecology for those wells located within one mile of the STF site.

A municipal well field that supplies water for the City of Tacoma is located 3,000 to 7,000 feet north-northeast of the site (1A through 9A, 11A, 12A, 2B, 10B). Some of the wells in this field are high capacity with the capability of producing flows in excess of 3,000 gpm. To the northwest, the town of Fircrest and University Place each have three wells within 8000 to 10000 feet of the site. The report on the Iron Foundry concludes that these six wells are not down gradient of the site.

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	DEPTH OF WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
CBS-01	471331	1222907	30.0	30.0	23.0	215.6	10/14/82	12.8	29.5	SAND	Y	N	Y	Y	1	
					21.5	217.1	11/24/82								1	
					27.14		08/22/89								2	
					27.9		09/12/89								2	
					22.9		01/24/90								3	
CBS-02	471317	1222915	33.0	33.0	27.2	213.1	10/14/82	7.0	33.0	SAND	Y	N	Y	Y	1	Partially plugged by vandals (ref. 4)
					23.5	216.8	11/24/82								1	
					31		08/22/89								2	
					31.52		09/12/89								2	
					21.1		01/24/90								3	
CBS-03	471258	1222918	44.0	44.0	36.0	213.6		20.0	44.0	SAND					1	
					33.0	216.8									1	
					41.91		08/22/89								2	
					42.57		09/12/89								2	
					32.4		01/24/90								3	
CBS-04	471237	1222987	43.5	43.5	34.5	216.3	10/14/82	3.5	43.5	SAND	Y	N	Y	Y	1	
					32.8	218.0	11/24/82								1	
					36.75		08/22/89								2	
					37.5		09/12/89								2	
					32.8		01/24/90								3	
CBS-05	471227	1222918	29.0	27.7	19.5	217.4	10/14/82	2.5	29.0	SAND					1	
					18.4	218.5	11/24/82								1	
					23.17		08/22/89								2	
					23.8		09/12/89								2	

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	DEPTH OF WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
					20.2		01/24/90								3	
CBS-06	471259	1222929	27.0	26.8	19.8	213.3	10/14/82	15.5	28.0	SAND	Y	N	Y	Y	1	Partially plugged by vandals (ref. 4)
					17.5	216.6	11/24/82								1	
					23.8		08/22/89								2	
					24.4		09/12/89								2	
					16.0		01/24/90								3	
CBS-07	471258	1222907	48.0	48.0	41.3	213.1	10/14/82	43.0	48.0	SAND					1	
					38.3	216.1	11/24/82								1	
					dry		08/22/89								2	
					dry		09/12/89								2	
					37.7		01/24/90								3	
CBS-08	471239	1222931	18.0	18.0	9.7	214.3	10/14/82	11.0	18.0	SAND	Y	N	Y	Y	1	
					7.0	217.0	11/24/82								1	
					11.9		08/22/89								2	
					12.98		09/12/89								2	
					6.7		01/24/90								3	
CBS-09	471227	1222931	34.0	33.5	26.2	216.1	10/14/82	22.0	33.5	SAND	Y	N	Y	Y	1	
					26.4	215.9	11/24/82								1	
					28.85		08/22/89								2	
					29.37		09/12/89								2	
					29.0		01/24/90								3	
CBS-10	471227	1222905	44.0	43.8	37.2	218	10/14/82	16.5	44.0	SAND	Y	N	Y	Y	1	

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	DEPTH OF WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
					36.3	218.9	11/24/82								1	
					40.2		08/22/89								2	
					40.74		09/12/89								2	
					37.6		01/24/90								3	
CBS-11	471239	1222906	44.2	44.2	37.0	216.8	10/14/82	36.0	44.0	SAND	Y	N	Y	Y	1	
					35.7	218.1	11/24/82								1	
					39.72		08/22/89								2	
					40.17		09/12/89								2	
					36.5		01/24/90								3	
CBS-12	471248	1222924	33.0	32.8	24.5	214.0	10/14/82	1.5	34.0	SAND	Y	N	Y	Y	1	Partially plugged by vandals (ref. 4)
					21.2	217.3	11/24/82								1	
					28.22		08/22/89								2	
					28.8		09/12/89								2	
					21.5		01/24/90								3	
CBS-13	471259	1222929	99.0	96.0	16.5	216.5	11/24/82	64.5	82.0	GRVL	Y	N	Y	Y	1	Partially plugged by vandals (ref. 4)
								82.0	84.0	CLAY					1	Abandoned (ref. 3)
								84.0	99.0	SAND					1	
CBS-49	91' from NW corner and 147' from NE of General Plastics bldg													Y	6	railroad well, abandoned.
STM 1	near south end of site														4	STM 1-4 was built by ReTec in 8/86
STM 2	near south end of site															no information on use

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	DEPTH OF WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
STM 3	near south end of site															
STM 4	near south end of site															
MW-5	near iron foundry		39.5	40						SDGL			Y		5	Drilled 11/87 solely to sample for organic priority pollutants
WELLS ADJACENT TO THE SOUTH TACOMA FIELD																
CH2M-2	471350	1222801	180.0	180.0	120.3	219.1	11/30/83	40.0	180.0	SDGL	N	N	Y	N	7	
					118.0	221.4	02/29/84								7	
					117.54	221.92	04/04/84								7	
CH2M-4	471403	1222757	82	75	30.64	219.22	11/30/83	53.0	75.0	SDGL	N	N	Y	N	7	
					29.18	220.68	02/29/84								7	
					28.83	221.03	04/04/84								7	
MW-A	471359	1222755	68	61	228.16	221.56	02/29/84	45.0	70.0	SDGL	N	N	Y	N	7	
					27.78	221.94	04/04/84								7	
MW-B	471358	1222809	68	61	21.72	222.14	02/29/84	35	57	SDGL	N	N	Y	N	7	
					21.24	222.62	04/04/84								7	
CH2M-3	471359	1222743	80	75											7	Elevation data innacurate (ref. 1)
MW-C	471355	1222815	58	53	30.1	222.2	02/29/84	20	40	SAND					7	
					29.61	222.69	04/04/84	40	50	STCL					7	
								50	53	SDST					7	

TABLE 3-1

WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
WCC-4A	471353	1222822	95.5	95	29	218.02	07/30/85	70	73	GRVL	Y	Y	Y	N	7	
					29.26	217.76	08/02/85	73	89	SAND					7	
					29	218.02	08/12/85	89	92	GRVL					7	
WCC-4B	471354	1222821	47	47												
					37	210.14	08/01/85	37	47	SDGL	N	N	N	N	7	
					28.79	218.35	08/02/85								7	
					28.94	218.2	08/12/85								7	
CBW-07	471348	1222821	100	99	40.7	216	10/26/82	48	100	GRDS	N	N	Y	Y	7	
CBW-08	471342	1222821	146	142.8	77.3	217	11/01/82	111.5	136	GRDS	N	N	Y	Y	7	
								136	137.5	STCL					7	
								137.5	143	SAND					7	
CH2M-1	*	*	110	72	39.61	216.18	11/29/83	30	60	SAND					7	
					36.64	219.15	04/04/84	60	70	SDGL					7	
WCC 1-A	471352	1222811	138	132	39	216.67	09/17/86	117	229	GRSC	N	N	Y	*	7	
					45.21	210.4	03/21/86	119	127	GRVL					7	
								127	132	SDGL					7	
WCC 1-B	471352	1222811	72	66	37	218.6	09/17/85	51	52	GRSC	Y	Y	Y	N	7	
					33.89	221.7	03/21/86	52	65	SDGL					7	
								65	67	GRSC					7	
WCC-2	471356	1222806	50	48	33	219.84	07/15/85	32	50	GRVL	N	N	N	N	7	
					32.25	220.59	08/02/85								7	

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
WCC-3	471348	1222815	51	45	31	225.71	07/17/85	34	45	SAND	N	N	N	N	7	
					38.35	218.36	08/02/85								7	
					38.46	218.45	08/12/85								7	
WCC-5	471352	1222816	60	56	37	218.35	08/05/85	36	42	GRDS	N	N	N	N	7	
					36.63	218.73	08/12/85	42	56	GRVL					7	
WCC-6	471353	1222807	78	70	56	200.54	08/02/85	49	55	SAND	N	N	N	N	7	
					37.58	21.96	08/12/85	55	66	SDGL					7	
								66	75	SDCL					7	
WCSB-1	471355	1222012	40	31	35	218.81	07/24/85	4	15	GRVL	N	N	Y	N	7	
								15	25	SAND					7	
								25	31	GRVL					7	
WCSB-2	471355	1222811	41	31	35.5	118.87	07/24/85	2	7.5	STCL	N	N	N	N	7	
								7.5	28.5	SDGL					7	
								28.5	41	SAND					7	
WCSB-3	471354	1222811	41.5	31	35.5	218.44	07/23/85	2	30	SDGL	N	N	Y	N	7	
								30	41.5	SAND					7	
WCSB-4	471352	1222812	41	31	35.5	219.19	07/25/85	5	28.5	SDGL	N	N	Y	N	7	
								28.5	41	SAND					7	
WCSB-5	471352	1222811	40.5	31	36	218.49	07/26/85	7	30	SDGL	N	N	N	N	7	

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	DEPTH OF WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
WCSB-6	471354	1222013	45	31	36	219.52	07/30/85	0.5	25	SDGL	Y	N	Y	N	7	
								25	46	GRVL					7	
WCSB-7	471352	1222813	45.7	31	35.5	218.3	07/29/85	2	9	SDGL	N	N	N	N	7	
								9	36.5	GRVL					7	
WCSB-8	471352	1222813	45	45	37.8	217.15	08/01/85	14	45	SDGL	N	N	N	N	7	
WCSB-9	471354	1222817	45	45	35.5	221.05	07/31/85	1.3	32.5	GRVL	N	N	N	N	7	
								32.5	42	SDST					7	
								42	45	SDGL					7	
CBW-10	471348	1222811	169	169	127.9	208.5	11/19/82	140	250	SAND	N	N	Y	Y	7	
								150	169	GRVL					7	
CBW-04	471341	1222810	187.7	187	123.8	218	09/22/82	144	173	GRVL	N	N	Y	Y	7	
								173	174.5	SDST					7	
								174.5	186	GRVL					7	
CBW-01	471346	1222821	58	58	44	216	09/20/82	44	58	GRDS	N	N	Y	Y	7	
CBW-02	471336	1222836	157	147.8	66.3	214	09/14/82	12.5	145	SAND	N	N	Y	Y	7	
								145	155	GROS					7	
CBW-05	471337	1222822	197	188.2	95	215	09/14/82	184	203	GRSC	N	N	Y	Y	7	
CBW-06	471337	1222822	158	158				124	158	SDGL	N	N	Y	Y	7	

TABLE 3-1
WELL DATA SUMMARY

NAME	LATITUDE	LONGITUDE	LEVEL DATA, FT. DEPTH OF HOLE	WELL	DEPTH TO WATER	WATER LVL ELEVATION	DATE	GEO/HYDROLOGICAL DEPTH (FT) TO TOP	BTM	LITH.	CONTAMINANTS PEST.	PCB'S	OTHER ORGAN.	METALS	DATA SOURCE	COMMENTS
CBW-09	471335	1222831	161.5	161.5	99.2	214	11/11/82	114	151.5	GRSC	N	N	Y	Y	7	
								151.5	161.5	SILT						
CBW-11	471339	1222025	159	158.9	96.7	215	11/17/82	143.5	159	GRVL	N	N	Y	Y	7	
CBW-03	471328	1222819	199	196.5	18.07	307	09/22/82	146	193	GRVL		N	Y	Y	7	

Reference Key:

1 EPA Groundwater Site Database 9/13/89 South Tacoma Swamp
2 Water Table Contour 1988 & 89, and Water Level 10/6/89
Prepared by Black & Veatch Waste, Tacoma for EPA
3 Water level in 1990 for B&V 1/25/90, Prepared by SAIC for EPA
4 Volume 1, RI/FS Work Plan for the Glacier Park Co. Site 11/87
Prepared by ReTec for Burlington Northern Railroad
5 Site Investigation/Surface Waste Removal: Former Iron Foundry 5/88
Prepared by Kennedy/Jenks/Chilton for TIP Management
6 Preliminary Site Investigation, 6/83
Prepared by Black & Veatch for EPA
7 EPA Groundwater Site Database 9/13/89 Tacoma Well 12A

Residential Wells.

Information supplied by the Department of Ecology indicated that 41 wells are within one mile of the STF site boundaries. However, this well information is obviously incomplete as not all of the wells known to exist at the STF site were listed. Additionally, it was often impossible to distinguish between those wells that were used for obtaining water from human consumptions and those wells delegated to monitoring activities.

Based on a search of the well logs, the closest water-supply well is located approximately 2,500 feet west of the site at (b) (6) This well is 110 feet deep and has a reported high concentration of iron.

3.1.4 Meteorology

In general, climatic conditions in the Tacoma area are moderate. The regional climate is controlled by air movement from the Pacific Ocean and by major landforms such as the Olympic and Cascade mountain ranges. Summers are moderately warm but excessive temperatures are not common except at higher elevations. The heaviest precipitation occurs during the winter months with lighter and less frequent rainfall occurring during the summer. Often, several weeks will pass with no rainfall during the summer months. Frequent rain is encountered during the rest of the year, especially later in the Fall and during the winter.

Climatic data from the weather station at Puyallup for the years 1951 to 1974 were examined to provide the following description of climatic conditions in the area of the STF site. Puyallup is situated a few miles east of the City of Tacoma and contains weather data typical of the those data that might be obtained in areas of low elevations in the western part of the county.

During the winter months (December through February) the average temperature is 40.5 degrees Fahrenheit (^{o}F), and the average daily minimum is 33.1 ^{o}F. The lowest temperature ever recorded was 0 ^{o}F and occurred in 1955. For the summer months (June through August), the average temperature is 62.9 ^{o}F and the average daily maximum is 76.4 ^{o}F. The highest recorded temperature of 101 ^{o}F also occurred in 1955.

The average date of the last freeze is around May 2 with one year in 10 having the last freeze later than May 20. The first freezing date in the fall, on the average, is around October 13. In one year in 10 the first freeze will take place before August 20.

The average annual precipitation at Puyallup for the years of record (1951-1974) was 41 inches. Elsewhere (Black and Veatch, 1987), state that the average annual precipitation is from 37 to 41 inches. Regardless, of the total precipitation, about 25 percent typically falls during the period from April through September. The heaviest 1-day rainfall during the period of record was 3.28 inches. Approximately six thunderstorms occur each year with three of those storms occurring in the summer.

In most winters, one or two large storms occur. These large storms bring damaging winds and accompanying rain. Occasionally, the rains cause flooding to occur in the lower elevations. Every few years, a large invasion of continental airmass from the east causes abnormal temperatures. Depending on whether the airmass invasion occurs in the summer or winter, several consecutive days can have sweltering or freezing temperatures.

The average relative humidity in midafternoon in spring is less than 72 percent; during the rest of the year it is about 75 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The percentage of possible sunshine is 63 percent in summer and 51 percent in winter. The prevailing direction of the wind is from the southwest. Average windspeed is highest, 10.4 miles per hour, in January.

3.2 BIOLOGICAL CHARACTERISTICS

The biological flora and fauna associated with the STF site have not been inventoried. The description of biological conditions provided below is based on a brief site visit and file records. A more detailed inventory must be developed to assess the potential environmental effects associated with contaminants found at the site.

The STF site is a fairly level grassland habitat with scattered shrubs and trees growing throughout the property. Some of the trees appear to be stressed, as evidenced by dead or highly stressed leaves on a single side of the tree. These trees may be indicators of a concentrated area of contamination that is being taken into the tree through one portion of the root system. Such biological indicators will be considered in the development of the sampling plan.

The grassland and shrubs would appear to provide excellent habitat conditions for rabbits, rats, and field mice. One rabbit was seen during the site visit, and reports from some of the PRPs indicated that rabbits are common at the site. No direct observations or reports of rats were made. The abundance of food (from the dumped garbage, grasslands, and nearby landfill) and old vacant buildings appear to provide good habitat for rats. Dogs and cats that use the site from the nearby neighborhoods may, however, control the population of rabbits and rats.

The habitat associated with the western edge of the site includes current and remnant wetlands, a steep bluff, and a moderately large coniferous woodlot. The presence of this habitat, in direct association with the site, increases the potential diversity of the animal community that utilizes the site. There may be a relatively diverse animal community that utilizes the site, particularly considering the urban location.

The site, and the associated woodland and wetlands, provide good habitat conditions for birds. The open grasslands and scattered trees provide habitat for raptors, pheasants, and a variety of songbirds. Mallard ducks have been observed using the wetlands. The "edge habitat" on the western site boundary (i.e., the combined grassland, wetland, and woodland habitat) further increases the diversity of bird species that potential may utilize the site. The most important on-site ecological habitat value of the relatively undeveloped site, in fact, may be its importance to birds.

Small wetlands are still present at the site. The site, formerly known as South Tacoma Swamp, previously included the northern portion of a wetland that extended roughly two miles to the south to the headwaters area of Flett Creek. Two small lakes containing bass and trout were present at the site during the 1940s and 1950s (see Section 5 for further descriptions). Although most of the South Tacoma Swamp has been filled and developed, the nature of the fill materials and its hydraulic connection with either Flett or Leach Creeks is largely unknown. It is currently unknown whether or how the conditions of the site may presently or potentially affect aquatic resources. The sampling plan will examine the potential for contaminants to emigrate from the site in surface runoff into the storm drain systems. NOAA, the Department of the Interior (DOI), and the Washington Department of Fisheries should be kept appraised if a direct or indirect pathway of contaminants is found from the site to these creeks.

Flett and Leach Creeks are tributary streams to Chambers Creek. Coho salmon ascend throughout the entire lengths of Flett and Leach Creeks when winter flows fill these creeks to capacity. Coho spawning migrations in Chambers Creek occur with the beginning of fall rains, normally the end of September, and extent into January. Intergravel egg development extends into March, when fry begin emerging from the gravel. The juvenile salmon typically reside within the stream system for more than a year before seaward migration occurs.

Chum salmon utilize the lower parts of Leach and Flett Creeks. Chum spawning migration occurs from the middle of October to mid-January. Chum salmon fry emerge from the gravel starting in late February and extending into May. These small juveniles migrate directly to the marine environment following emergence from the gravel.

The Washington Department of Natural Resources was contacted to search the Natural Heritage Data System for information regarding significant natural features in the vicinity of the site. No records were found in the data recording system regarding rare plants, high quality native plant communities, or native wetlands in the vicinity of the project. The National Heritage Data System is not a complete inventory of Washington's natural features, however, as many areas of the state have not been adequately surveyed. The potential that significant natural features exist that are currently not recorded under this system is evident by the fact that this system did not report the existence of the large wetland that was formerly associated with this site.

No endangered species are known to occur at nor near the site. According to the Department of the Interior (DOI), however, a federal candidate endangered species, Arenaria paludicola (swamp sandwort) is present approximately 1.5 miles from the site. This species is found in freshwater wetlands. Because of the presence of freshwater wetlands and the proximity of the species to the site, it is possible that this species may be present at the STF site itself. The U.S. Fish and Wildlife Service should be contacted to conduct a site survey to search for the species in the STF wetland.

3.3 CULTURAL CHARACTERISTICS

The Washington State Office of Archaeology and Historic Preservation was contacted regarding the presence of known archeaological and historic resources located at the STF site. Review of the Washington State Inventory of Cultural Resources indicated there are no prehistoric archeological resources that are known to be present in this vicinity. A representative of their office did indicate that the project area historically has been devoted to industrial use (industrial uses of the site are described in Section 5 of this report) and concluded, therefore, that industrial archaeological sites are likely present. Structures documented on historic property inventory forms include the Northern Pacific Railroad Shops and the Griffin Wheel Company buildings.

Flett, Leach, and Chambers Creeks are within the usual and accustomed fishing grounds of the Puyallup, Nisqually, and Yakima Indian Tribes, and possibly others as adjudicated in the United States v. Washington and other cases. Under the applicable treaty, the United States Government has a fiduciary responsibility to protect the resources reserved by the tribes which migrate through or by the reservation, and to protect such stocks in which the tribes have an interest throughout its migratory range. This responsibility is assigned to the Department of the Interior. According to Jonathan Deason, Director of Environmental Affairs, DOI has a direct interest in not only protecting the species, but also the habitat necessary for substance and reproduction of that species. Therefore, DOI is particularly concerned with any potential for contamination from the STF site to harm the fishery resources of Flett, Leach, and Chambers Creeks.

4.1 SOUTH TACOMA CAR SHOPS

The South Tacoma Car Shops site comprises the largest block of area in the STF site (Figure 4-1). It consists of an area running along the eastern edge of the site with dimensions of about 7000 feet north-south and up to 1000 feet east-west.

Northern Pacific Railroad purchased land at STF in the early 1890s and opened a manufacturing and repair facility in 1892. The facility, which consisted of several large brick buildings and at least one roundhouse, was used to build a variety of rail cars, including passenger and several types of freight cars, tool cars, wrecking cars, and cabooses. It was also used for repair and maintenance of existing equipment, such as repair and rebuilding of engines, repair and reinforcement of cars, construction and repair of boilers and tanks, and cleanup of all cars arriving for repair or maintenance. The size of the work force over time is unknown, but 800 to 1,200 individuals are believed to have worked at the site in the early 1900s. Initially, the complex covered approximately 100 acres, but expanded to over 200 acres in two decades.

The South Tacoma Car Shops developed by Northern Pacific Railroad operated from the 1890s until it was closed in 1974. In the 1960s, according to one individual, the engine repair facility was moved to Auburn and Montana and a few buildings began to be torn down. The remaining operations were primarily car maintenance, repair, and reclaiming, where cars and engines that were abandoned were disassembled for reusable parts. In March 1970, Northern Pacific Railroad merged with the Great Northern, Chicago, Burlington and Quincy, Spokane, Portland and Seattle, the Pacific Coast Railroads in the creation of the Burlington Northern Railroad Company. As a result of consolidating these operations, the South Tacoma Car Shops were no longer needed and were closed in January 1974. The final demolition of the structures on the Car Shops site was done by Ace Construction Company of Spokane. Those familiar with the project noted that one wooden building was moved to Montana, some of the bricks were saved and moved to California, several pits were filled with rubble, and wood was buried in the area south of the airport facility. All of the existing structures from the Car Shops were demolished by spring 1976. At least one underground tank still remains in place.

The current owner of the Car Shops area is Glacier Park Corporation, a former corporate subsidiary of Burlington Northern Railroad. Glacier Park Corporation acquired the property from Burlington Northern in May 1986. Prior to this time, Glacier Park managed the property at the site on behalf of Burlington Northern. Since 1973, Burlington Northern has been involved in a redevelopment process for the Car

Shops site and hired Seifert & Forbes, consulting engineers in Tacoma, to work on this project. As a result of this effort, parcels of the Car Shop site were sold to General Plastics Manufacturing Company, Coors of Tacoma, Inc., Platt Electric Co., and South Tacoma Motor Company in 1979. General Plastics has built a manufacturing facility on their land, but Platt, Coors, and South Tacoma Motors have resold their parcels to Burlington Northern. In the case of South Tacoma Motors, the resale was prompted by evidence of contamination of the particular parcel (Lot 25). In 1986, Pioneer Builders, Inc. purchased two lots and are currently in the process of building a distribution center.

During their operation, the South Tacoma Car Shops were almost totally self-sufficient, making most of their materials or recycling them from already used products. The facility had its own water supply which arose from a well and pump house in the central yard. Several lavatories, mess halls, lunch rooms, and bunk houses were located throughout the site. A historical description of the activities in the Car Shop area follows. The description starts in the southern portion of the shop area and moves north.

The south end of the Car Shops area contained the clean-out track where incoming cars were routinely cleaned out before repair or maintenance work was conducted. One well boring in this area (boring number 8 reported in Dames and Moore, 1974) found brick, sand, ash slag, and glass fragments down to a depth of 20 feet. Lime and sulfur deposits as well as barrelled waste has also been found in this area.

Located in the southern portion of the Car Shops area, just to the east of Griffin Wheel, was the locomotive blacksmith shop. Here, they painted locomotives, did steel fabrication, and used several different types of oils in the maintenance of engines, valves, signals, and headlights. Heavy fuel oil for this shop was stored in tanks immediately to the east of this building. The building itself has a dirt floor which no doubt absorbed much of the above materials. In this area, locomotives were adjusted and underwent regular maintenance. Those to be discarded were sent up to the north end's "reclaiming" area for total dismantling.

In the south-central portion of the Car Shops area, there were several large buildings which were used for construction and maintenance of freight cars. Metal and wood construction as well as painting of the cars took place here. Exterior painting of the body, numbers, and interior varnishing was done.

Electrical work for some passenger cars, especially lighting and fans, was also performed in this area. Quantities of wood products and steel were stored in this area and can be seen quite readily in aerial views.

The caboose cleaning area was located in the central portion of the car shop area, east of the Wheel Shop along the tracks. This operation used strong cleaning solvents as well as toxic soap. The cleaning solutions were reportedly sprayed off with water and then simply soaked into the ground; workers were reportedly required to wear a mask during these activities.

In the north-central portion of the shop area there was another large paint shop. Those interviewed said they stored paint here, mixed it, and frequently saturated the ground. They washed brushes with paint thinner and also discarded this liquid on the ground. The empty paint cans and old brushes were reportedly burned in a large pit about 30 feet west of the north end. Materials were also reportedly burned in barrels here and scraps of wood, paint rags, etc. were burned in an open area on a regular basis.

The dismantling yard, the major "reclaiming" area, was located in the northern portion of the Car Shops area. Prior to repair or dismantling, the cars were cleaned out and many of the non-flammable, non-recyclable discarded materials, including asbestos, were buried in a major trash dump located at the west end of the dismantling tracks. Aerial photographs show that heavy equipment was used to bury trash here. Additionally, several burning areas were used in the open space between the storage yard and the "reclaiming" area; wood from box cars was stripped of metal and burned here as were railroad ties and other woods soaked with tar, grease, and oil. Those interviewed noted thick black smoke in the area on a frequent basis.

As part of the dismantling process, bolts and axles were cut with torches and the separated babbitt and brass was returned to Griffin Wheel Company. Oil and grease reportedly saturated the ground in the area around the gantry crane, especially the west end, where locomotives were dismantled and metal parts were always scattered on the ground. Just to the west and south of this area was a cement plant that made "planks" for railroad crossings.

4.2 GRIFFIN WHEEL FACTORY

American Foundry Company operated a foundry facility and plant at the STF site from October 1890 to 1896. In January 1897, Griffin Wheel, a division of Amsted Industries, bought the facility and operated two foundries there: one brass and one iron. The brass foundry was located at the south end of the STF site on the property still owned by AMSTED and produced journal bearings until April 1980. It was demolished in 1989. The iron foundry produced iron wheels until 1957, when the railroads switched to steel wheels. The iron foundry building, located in the central portion of Tacoma Industrial Park, is currently used for other manufacturing activities.

Based on discussions with individuals knowledgeable of past operations at the site, the old iron foundry produced iron wheels for railcars. Iron was delivered to the site in billets, which consisted of relatively pure iron that had been produced at other foundries. The iron billets were used to make the iron wheels which were formed by a simple heating and molding process.

The major activity at the brass foundry was the production of journal bearings. Journal bearings are babbitt-lined brass casting that fit on an axle journal at the ends of the axles. The brass foundry made these bearings both by recasting used bearings supplied by the railroad, and by casting raw materials into bearings. Griffin Wheel also performed the lining of the bearing with babbitt metal. This type of bearing was in use from the beginning of railroading until the introduction of the steel roller bearing in the late 1940s. Journal bearings continued to be manufactured at the site to supply replacement parts for older railcars.

The brass material used to manufacture the bearings was composed of lead, tin, copper, and zinc. Used bearings were melted down and lead, tin, and zinc were added to bring the brass up to railroad alloy specifications (lead 16 to 24 percent; tin 5 to 7 percent; copper 67 to 77 percent; and zinc 4 percent; Simmons-Boardman, 1922).

The babbitt material contained lead, tin, antimony, copper, and zinc (lead 88.3 to 88.6 percent, tin 3.5 percent, antimony 7.5 percent, and traces of copper and zinc). Some babbitt metal came into the foundry on the used bearings, the remainder was purchased from Federated Metals in Portland. Babbitt metal was not manufactured at the foundry (Reid, 1986).

The journal bearings were cast in sand, which was reused many times before replacement (about once every two to three years). Scrap from the casing and grinding processes was also reused. Unusable brass and babbitt skimmings were stored outside temporarily and then sold.

Modifications to the brass foundry ventilation system were installed in the mid-1950s following a survey of lead levels in air inside the building in 1952 and 1953 by the University of Washington. A subsequent survey of lead levels in the air inside the foundry building was conducted in 1955 also by the University of Washington. This study found that, although reduced from 1952 and 1953 levels, lead was generally found in building air at levels above maximum allowable concentrations established by Washington State law (0.15 mg/m 3) (University of Washington, 1955).

In late 1972, a baghouse was installed to collect particulate matter in the exhausts from the various processes. Baghouse dust was spread on the ground west of the foundry building (Reid, 1986). Some of the exhausts (grinding and casting processes) were routed through a machine which collected the dust and wet it down to prevent it from spreading (Reid, 1986). In addition, slag and tailings from the foundry operation were deposited on the west side of the foundry (Pierce, 1982).

4.3 SOUTH TACOMA AIRPORT

The South Tacoma Airport is about a 70-acre site that was used as an airport form 1936 to 1973. The airport site is about 5500 feet in length (north-south axis) and up to 1000 feet in width at its widest point. The airport property runs along the western side of the Car Shops site; the northern portions of the airport and Car Shops site are adjacent; southern portions of the properties are separated by the Griffin Wheel Company site.

This particular site was first utilized as an airport facility in 1936 when Vernon C. Hubert and his partner, a Mr. Dillion, operated a small runway. They operated the airport until the outbreak of World War II when all private flying was moved to eastern Washington at McChord Air Force Base and Fort Lewis. After the war, according to a 1947 Airport Directory prepared and published by the Washington State Aeronautics Commission, the facility is referred to as "Tacoma Air Park" and Mr. Hubert is listed as manager. The Directory lists two runways, both turf, running north and south (2000 feet by 100 feet and 34 feet by 250 feet). At the time, fuel and a major repair facility were available at the airport. Around this time, Vincent Cavasino from the Dakotas took over operation of the airport and ran a flight school until early 1950 when the facility closed. Evidently the airport sat dormant until 1955-'56 when

Charles L. Gross moved his own plane there and started-up the facility once again. It was a private airport with public use. During the late 1950s and 1960s, it was probably the second largest in the state. The 1963 AOPA Airport Directory lists Cross Aviation as the operator of the "South Tacoma Airpark" with one runway of gravel and turf (3400 feet), three different octanes of fuel, a major repair facility, and runway lights. The 1964 Washington State Air Facilities Map referred to the site as the "South Tacoma Airport," the name most commonly used among aviators. During this time, Cross Aviation chartered and rented airplanes, ran a flight school, and was an approved Beechcraft sales and service representative. Mr. Gross closed the airport in 1973 through 1974 due to increasing taxes on the property.

In discussing the airport with Mr. Gross, he mentioned the fact that a lake used to be located past the south end of the runway and that in the late 1940s they used to land seaplanes on it. Mr. Gross had the longer runway rebuilt. It was made of "oil mat" whereby rock and sand was spread, rolled-out, and then sprayed with "paving oil" and left to set for a week or so. He also noted that the City had a through street near the runway (probably Madison Street) and that they maintained its surface in the same manner.

On the airport site, beginning at the north end, was a repair building, and office building, an open space for tiedowns, a large hangar, and several small hangars. Gross indicated that all repairs were done in the north building and they used very little oil, solvents, etc. Any excess oil was kept in surface barrels and hauled away on a regular basis. He noted that the underground gasoline tanks were dug-up and removed by the Kendall Company when the airport closed. Mr. Gross also noted that he never recalled having anything that could be called "hazardous" in the area. Mr. Gross resided in the Tacoma area and is available for further questions.

4.4 SOUTH TACOMA SWAMP

A 1889 Tacoma map, Palmer's Complete Atlas (1889), shows that the South Tacoma Swamp covered a large area that extended from South 40th Street to Steilacoom Boulevard located approximately 2 miles south of South 56th Street (Figure 4-2). In 1930, Garland described the South Tacoma Swamp area and presented plans for converting the swamp into a park. According to Garland, the area was approximately 3 miles long and from .25 to .50 miles wide, extending from South 40th Street to Steilacoom Road. However, Garland emphasized that the swampy area extended from South 56th Street to Steilacoom Road and that the north end of the swamp was covered by a lake. The lake

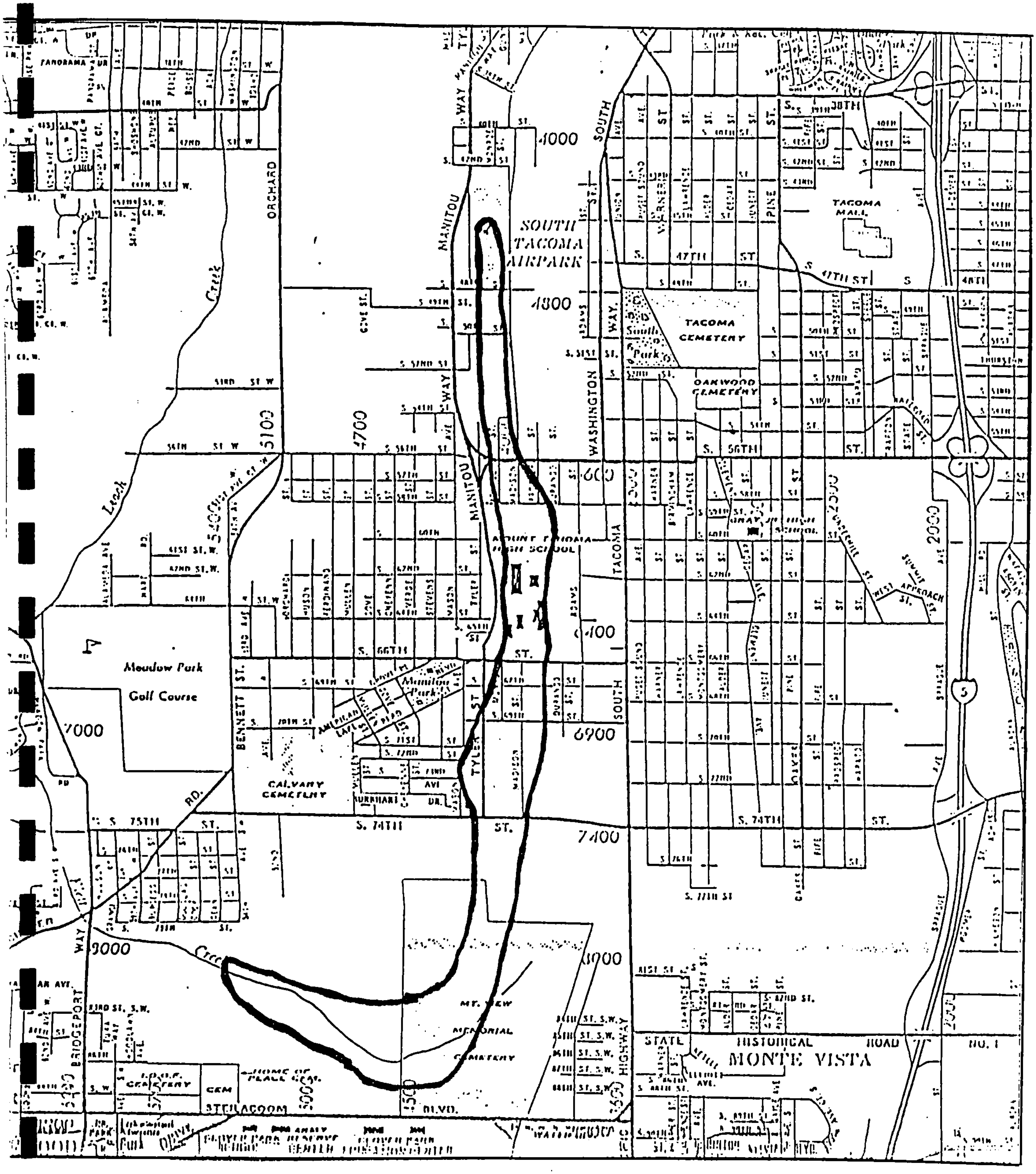


FIGURE 4-2

OVERLAY OF SOUTH TACOMA SWAMP, AS DEFINED IN 1889, ONTO CURRENT TACOMA CITY STREET MAP was 16 blocks long (probably located from South 40th Street to South 56th Street), from 4- to 18-feet deep, was fed by springs, and was stocked with trout and bass. Flett Creek ran through the swampy area. Also according to Garland's descriptions, a 30-inch sanitary sewer pipe discharged its overflow into the swamp on the south side of South 56th Street near a dump (Garland 1930). This unregulated swamp dump was reported to be located below the south side of South 56th Street. The swamp dump contained miscellaneous household materials, and items such as "hay wire, tin lizzies, and dead animals."

In January 1945, Tacoma Times reported that the City council and the health department conducted an inspection of a tract in the South Tacoma Swamp area. The tract contained several acres of debris including "old stoves, old car bodies, and a pail full of rabbit heads." After a sanitary fill had been placed in the swamp area, trash was dumped there in violation of City ordinance for several years. It was proposed that heavy equipment be used to clean up the swamp dump by removing the trash and covering the hole (Tacoma Times 1945a).

In February 1945, Tacoma Times reported that the public works department was almost finished cleaning up the swamp dump near South 56th Street and Tyler Street. The material accumulated on the top of the fill (old car bodies, tin cans, and other household items) was covered with gravel and dirt. The cover material consisted of the soil removed from the banks of a cut at South 56th Street and Sprague Avenue (Tacoma Times 1945b).

A 1950 Tacoma map (Tainer 1990) shows two lakes and a pond existed south of the airport site (Figure 4-3). Mr. Gross, who operated the adjacent airport, mentioned that the lake was used in the late 1940s to land seaplanes. He said the lake had fish in it and was fed by a stream that ran along a ditch from the north end of the property. He believes that the lake eventually disappeared as a result of the City of Tacoma's installation of a new sewer line in 1953, evidently involving some pick-up or diversion of surface water.

Mr. Gross also said Atlas Foundry "had permission" to dump their slag and sand in the lake bed. Atlas Foundry had manufactured a variety of new steel castings from remelted steel and alloys in Tacoma since 1899. From the inception of the foundry until 1968, all foundry wastes (casting sands and binders, slag, rock. floor sweepings) were disposed of in City of Tacoma landfill sites. In 1968, the City increased the rates it charged Atlas Foundry for the disposal of its wastes and the company looked for alternative disposal arrangements. At that time, an agreement was reached between

4.0 HISTORIC USES OF THE SITE

The STF site has been used for a variety of industrial purposes for approximately 100 years. The major historic uses of the site are summarized in this section. The information presented was obtained from previous reports prepared in association with this site. Information from those documents listed in Table 4-1 was considered. In addition, supplemental information was obtained in interviews with the current owners/managers of site facilities conducted in March 1990.

The purpose of this section is to present a summary of historic uses as a basis for developing the Remedial Investigation/Feasibility Study (RI/FS) Workplan. This section does not identify all past activities associated with the site, nor is it intended to be used as a basis for allocating financial or legal liability for remediation activities. The activities described and the organizations named were selected for inclusion based upon the availability of information and the degree that inclusion assists the development of general knowledge of industrial activities at the site.

The historic uses of the STF site are most easily summarized by identifying five major areas of land use. The geographic location of these major areas is presented in Figure 4-1 and include:

- South Tacoma Car Shops of Burlington Northern Railroad;
- Griffin Wheel Factory;
- City of Tacoma Power and Light;
- South Tacoma Airport; and
- South Tacoma Swamp.

Each of these areas is discussed in greater detail below. Additional information about site use can be found in Section 5, Current Uses and Site Security.

TABLE 4-1

LIST OF DOCUMENTS REVIEWED FOR THE DATA SUMMARY

REPORTS PREPARED FOR BURLINGTON NORTHERN RAILROAD

Quality Assurance/Quality Control Plan, South Tacoma Swamp RI/FS
(Revision 1 and Original Draft)
Prepared by ReTec, 3/87

Waste Sampling Plan for Surface Debris Mapping at the
Burlington Northern Railroad Site, Revision 1
(Includes surface debris sampling plan map from 2/87)
Prepared by ReTec, 3/87

Site History, Burlington Northern Railroad
Prepared by Jack Berryman, Consulting Environmental
Historian, 4/87

Phase 1 Report: Remedial Investigation of South Tacoma Swamp
Prepared by ReTec, 5/87

RI/FS Work Plan for the Glacier Park Co. Site, Volume I
Prepared by ReTec, 11/87

REPORTS PREPARED FOR TIP MANAGEMENT

Investigation/Surface Waste Removal: Former Iron Foundry Site
Prepared by Kennedy/Jenks/Chilton, 5/88

REPORTS PREPARED FOR AMSTED INDUSTRIES

Remedial Investigation/Risk Assessment/Feasibility Study:
Former Brass Foundry Area, Volumes 1 and 2
Prepared by Kennedy/Jenks/Chilton, 1/87

REPORTS PREPARED FOR PIONEERS BUILDING SUPPLY

Soil Sampling and Chemical Testing, Lots 2 and 3
Prepared by AGI, 5/87

REPORTS PREPARED BY TACOMA-PIERCE COUNTY HEALTH DEPARTMENT FOR TACOMA LIGHT

Investigation/Characterization of the Former Burlington
Northern Railroad Parcel, Final Report
Prepared by Tacoma-Pierce County Health Department, 4/86

REPORTS PREPARED FOR GENERAL PLASTICS

Geotechnical Engineering Study of the General Plastics Facility
Prepared by Earth Consultants, Inc., 9/80

REPORTS PREPARED FOR EPA

Preliminary Site Investigation, South Tacoma Swamp
Prepared by Black and Veatch, 6/83

Water Table Contour Maps and Water Level Data
Prepared by Black and Veatch, 10/89

Water Level Measurements Table
Prepared by SAIC, 1/90

Preliminary Summary of Previous Investigations Conducted
at the South Tacoma Swamp Superfund Site
Prepared by SAIC, 12/89

Evaluation of Status of Hazardous Waste Management in Region 10
Prepared by Battelle, 12/75

Potential Responsible Party Search, Volume I
Prepared by Jacobs Engineering, 12/87

After Action Report: Former Griffin Wheel Foundry
Prepared by Kennedy/Jenks/Chilton, 3/90

REPORTS PREPARED FOR PRP

Remedial Investigation/Feasibility Study, South Tacoma
Swamp Industrial Site
Prepared by Kennedy/Jenks/Chilton, 10/89

REPORTS PREPARED FOR CITY OF TACOMA

Remedial Investigation Report on Tacoma Landfill, Vol. I
Prepared by Black and Veatch, 12/87

ADDITIONAL INFORMATION

WDOE Memo, re ARARS - Applicable State Laws,
9/89

DOI Memo, re Natural Resource Survey Investigation,
12/89

WA State Dept. of Nat. Res. Memo, re National Heritage
Data System Search, 5/89

WA State Dept of Community Development, Office of Archaeology
and Hist Pres., re archaeological and historical resources, 6/89

NOAA Memo, re fish runs, 5/89

Grid Size Required to Detect Hot Spots Table
Kennedy/Jenks/Chilton Report, undated

EPA Groundwater Site Database, South Tacoma Swamp,
9/89

EPA Groundwater Site Database, South Tacoma Well 12A,
9/89

MAPS

Well Sites South Tacoma Swamp
Prepared by ReTec

Surface Debris Sampling Plan
Prepared by ReTec, 2/87

Historic Use of South Tacoma Car Shops
Prepared for Burlington Northern Railroad by ReTec, 5/87

South Tacoma Swamp Superfund Site
(Large Overview Map)

South Tacoma Swamp Superfund Site
Figures 2-1; 3-1; 4-1; 5-1 through 5-10; and 6-1 through 6-4
Prepared by ReTec

Kennedy/Jenks/Chilton Maps:
Historical Boundaries
PRP Property Boundaries (Fig. 2)
Proposed Soil/Debris/Slug Sampling (Fig. 2)
Burlington Northern Tacoma Industrial Center No. 1 (Fig. 1)

SOUTH TACOMA AERIAL PHOTOGRAPHS: 1941, 1946
1957
1968
1978
1985, 1988

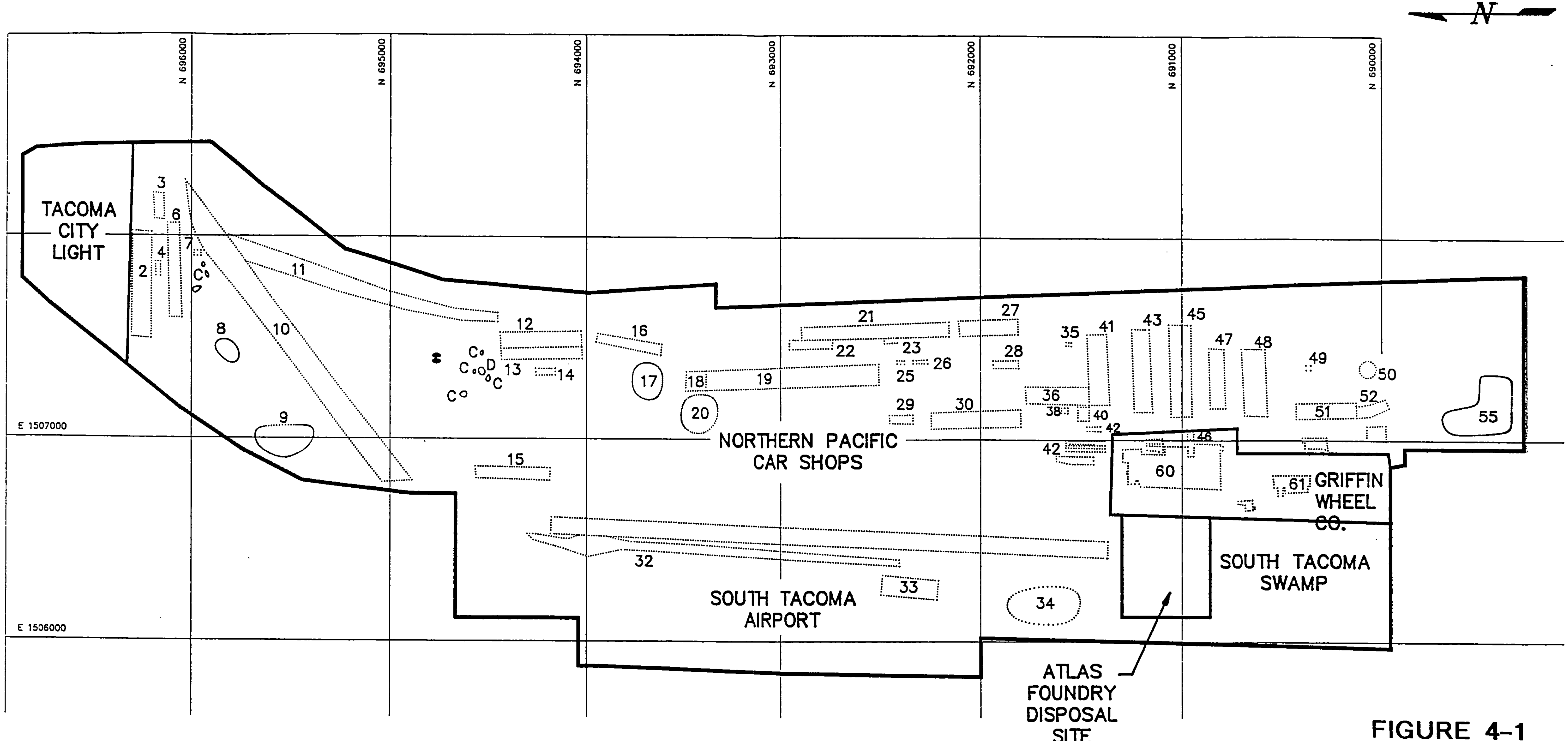


FIGURE 4-1

LEGEND

C Possible Buried Metal
D Surface Metal
2 Gantry Crane Area
3 Lantern Shed
4 Shed
6 Storehouse, Belt House Rolling Mill, Storage Bldg.
7 Fuel Cellar
8 Burn Pit
9 Trash Dump
10 Storage Yard
11 Rubbish Track Corridor
12 Concrete Floor
13 Blacksmith Shop
14 Sandblast Shed
15 Concrete Casting Plant
16 Car Castings Platform
17 Trash Burning Area
18 Paint Shop
19 Car Shop
20 Trash Pit (Paint Shop)
21 Freight Repair Shed
22 Open Shed
23 Paint Shop
25 Waste Soaking Vat
26 Paint House
27 Wheel Shop
28 Generator House (w/Settling Tank)
29 Dry Kiln
30 Finished Lumber Sheds
32 Landing Strip
33 Airport Building
34 Fisk Foundry Disposal Site
35 Drop Pit
36 Woodworking Shop
38 Dip Tank
40 Boiler House
41 Coach Shop
42 Oils Tanks
43 Paint Shop
45 Machine Shop
46 Solvent Shop
47 Boiler, Tin Tank & Copper Shop
48 South Machine Shop
49 Trash Burner
50 Turntable
51 Blacksmith Shop
52 Iron & Steel Storage
55 Railroad Cleanout Area
60 Iron Foundry
61 Brass Foundry

0 250 500
SCALE IN FEET

Base Map Reference
Walker & Assoc. 10-22-86
Surface Debris Sampling Plan
February 1987
For Sitts & Hill Engineers, Inc.
Retec Remediation Technologies, Inc.
South Tacoma Swamp
Taken from Kennedy/Jenks/Chilton
PSSK005-3/22/90

DATE	REVISIONS	BY

SOUTH TACOMA FIELD
MAJOR HISTORIC USES

APPROVED		APPROVED	
DRAWN	VM COX	CHECKED	
SCALE	1"=500'	DATE	
APPR. NO.		JOB NO.	

ICF TECHNOLOGY INCORPORATED
Bellevue, WA

N°	STF07.1	DATE: 3/29/90

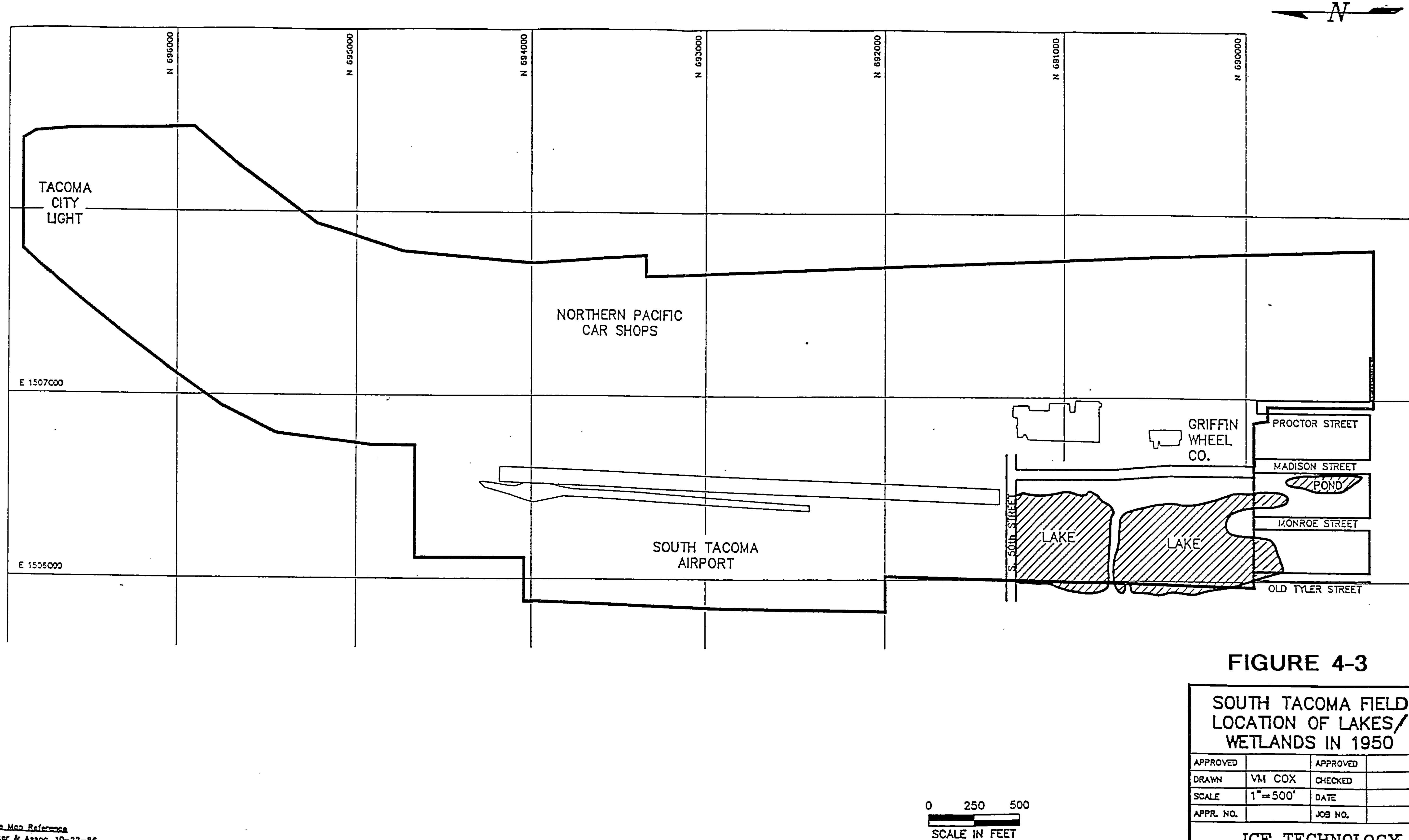


FIGURE 4-3

SOUTH TACOMA FIELD LOCATION OF LAKES/ WETLANDS IN 1950			
APPROVED		APPROVED	
DRAWN	VM COX	CHECKED	
SCALE	1"=500'	DATE	
APPR. NO.		JOB NO.	

ICF TECHNOLOGY INCORPORATED
Bellevue, WA

NO	STF05.1	DATE: 3/29/90

DATE	REVISIONS	BY

Base Map Reference
Walker & Assoc. 10-22-86
Surface Debris Sampling Plan
February 1987
For Sitts & Hill Engineers, Inc.
Retec Remediation Technologies, Inc.
South Tacoma Swamp
Taken from Kennedy/Jenks/Chilton
P9SK005-3/22/90

Burlington Northern Railroad Company and Atlas Foundry to allow Atlas to fill in a lowland section of Burlington owned property located at the southwest of the South Tacoma Airport (between Madison and Tyler Streets and between S. 50th and S. 52nd Streets) with non-combustible, non-garbage, earth-like foundry wastes. Subsequently, Atlas Foundry disposed of their foundry wastes (except baghouse dust) at the Burlington site (a.k.a., Atlas Foundry Dump Site) until 1980. Baghouse dusts continued to be disposed of in the City dump.

Following EPA and Washington Department of Ecology inspection of the dump site in 1980, Ecology forbid further dumping into two on-site ponds (which have since been filled in with material of unknown origins) due to concern for potential groundwater contamination. Atlas subsequently arranged to dump its foundry wastes in a gravel pit owned by Woodworth and Company, Inc., located at 2800 104th Street South, Tacoma, Washington. Atlas currently disposes of all foundry (non-combustible and non-garbage) wastes in the Woodworth gravel pit.

Ecology & Environment (E&E) personnel accompanied Atlas Foundry representatives during an inspection of the Madison Street dump site in (Atlas Foundry Dump). The area used by Atlas Foundry is located immediately to the southwest of the South Tacoma Airport runway, next to an unnamed tributary to Flett Creek. There was no activity at the site during the E&E inspection, but they reported that the disposal of foundry wastes apparently has continued at the site, including the recent disposal of several (more than 20) truck loads of what appeared to be foundry slag, sand, and old castings. The source of these wastes is unknown. The Atlas representatives admitted that the piles looked like foundry wastes, but they denied that the wastes were from Atlas Foundry, indicating that some of the colors in the slag were atypical of Atlas Foundry slag.

4.5 TACOMA POWER AND LIGHT

Tacoma Power and Light is a public utility that provides electric service and fresh water supply for the City of Tacoma. The utility has been operating at the STF site since 1953. Operations conducted at the site include all activities associated with the repair, maintenance, and distribution of equipment for electric and water service. The site includes office space; indoor and outdoor storage areas; above and underground storage tanks; full service automobile and truck maintenance and repair operations; and equipment repair shops. Approximately 600 individuals currently work on-site. Approximately 300 of these individuals provide office support for the operations. The remaining 300 individuals work in the service shops or with field crews operating out of this site.

Storage facilities warehouse new and used pipes, meters, pumps, transformers, circuit breakers, and utility poles (both treated and untreated). Virtually the entire site is currently covered with asphalt or buildings. The southern property line, which is completely covered with asphalt for outdoor storage, includes a three-inch curb which prevents surface runoff from flowing off the Power and Light Property and on to the Glacier Park property to the south. The asphalt is drained by storm drains that are modified dry wells. The dry wells have soil bottoms with inter-connecting piping to the City's storm drainage system.

The utility property has five underground and at least three aboveground tanks located on the site. Three 10,000-gallon underground tanks store unleaded and leaded gasoline. These tanks were installed in 1956, are made of bare steel, and incorporate no cathodic protection or containment systems. Leak detection is currently practiced through inventory reconciliation and annual pressure tests. The fourth underground storage tank is a 1,000-gallon fiberglass reinforced plastic tank that was installed in 1984. This tank contains diesel fuel and is managed for leak prevention/detection in the same way as the steel tanks. The fifth underground tank is a 400-gallon concrete tank used to store waste oils. Leak detection for the concrete tank is based on monthly dip stick measurements.

Three aboveground tanks capable of storing 6,000 gallons each are located in enclosed areas with complete secondary containment. These tanks are used to store new, used, and waste mineral oil. In addition, roughly 3,500 new and used transformers are stored on-site. These transformers are capable of containing 20-gallons of mineral oil per unit.

Much of the electrical equipment used by the utility uses mineral oil rather than polychlorinated biphenyls (PCBs). Mineral oils used in the electric utility industry are frequently contaminated with PCBs, however. This contamination often occurs when the transformers are filled with mineral oil because the same distribution system is typically used for filling transformers with mineral oil as is used for PCB-based equipment. According to Russell Post, Environmental Manager of the site, typical levels of PCB contamination in mineral oils in the Northwest are as follows:

- 50 percent of transformers < 1 ppm PCB;
- 45 percent of transformers contain 1 to 50 ppm PCB;
- 4 to 4.5 percent of transformers contain 50 to 500 ppm PCB; and
- less than 1 percent of transformers contain > 500 ppm PCB.

With the exception of Askarel (PCB based) equipment, the highest concentration of mineral oil contamination observed at the site to date contained 2300 ppm PCBs.

Hazardous substances/wastes stored on-site include PCBs, PCB contaminated mineral oil, pesticides and herbicides used primarily to maintain power lines areas. Pesticides and herbicides are stored in a variety of size containers ranging from 55-gallon drums to pint size containers. Although only a small amount of the electrical equipment is PCB based, trichlorobenzene may be present from past and current use of the Askeral equipment.

Tacoma Power and Light was interested in purchasing some of the adjacent property from Glacier Park for possible expansion of its facilities in the 1970s. The Tacoma/Pierce County Health Department conducted an investigation of the property. This property was not purchased because of the existence of environmental contamination and the potential associated liability.

Black and Veatch (1983) detected PCB contamination of soils in the area currently used to store transformers. These samples were collected in a small area, roughly 1/4 acre in size, that was not covered with asphalt at the time of the sampling. This area has since been paved.

The utility has recently conducted further investigations regarding the presence of PCB contamination of soils at the site. Results from these investigations are not presently available for public review, but confirm the presence of PCB contamination at the site (personal communication with Russell Post, March 1990). To date, no groundwater monitoring samples have been analyzed for contaminants. The utility operates two wells on-site as part of the heating and ventilation system. These wells are not used for potable water supply.

5.0 CURRENT SITE USES AND SECURITY

This section presents the activities currently occurring at the STF site and discusses site security. It is organized into three sections. Section 5.1 presents a discussion of recent and on-going industrial activities that occur at the STF site. These activities are also summarized in Figure 5-1. Section 5.2 summarizes recreational and other non-industrial activities that occur there. Lastly, Section 5.3 describes present security precautions that have been established to minimize potential exposure to contaminants prior to site restoration.

5.1 CURRENT INDUSTRIAL USES

Two new industrial/commercial complexes, General Plastics and Pioneer Builders, have been developed at the STF site within the past ten years. Several other industrial and commercial operations have operated in buildings formerly used in association of the iron foundry and the railyards. Each of these activities is discussed in this section.

5.1.1 General Plastics

In 1979, General Plastics purchased property that was previously the southwestern portion of the Car Shops Site. A manufacturing plant, used for the manufacture of high-density rigid and flexible polyurethane foams and high density rigid polyisocyanurate foams, was opened in 1981. These foams are used in the aviation, construction, marine, nuclear, industrial, architectural and sports equipments industries. About 100 are employed at the plant, including roughly 80 production workers and 20 administrative and management workers.

Prior to plant construction, concrete slabs and foundations associated with buildings previously located on the property were broken up, left in place, and surrounded by sand and fill. A well associated with previous rail operations was located within the area of the building. This well was reported to be closed and demolished.

General Plastics currently has one underground storage tank that was installed for spill containment purposes.

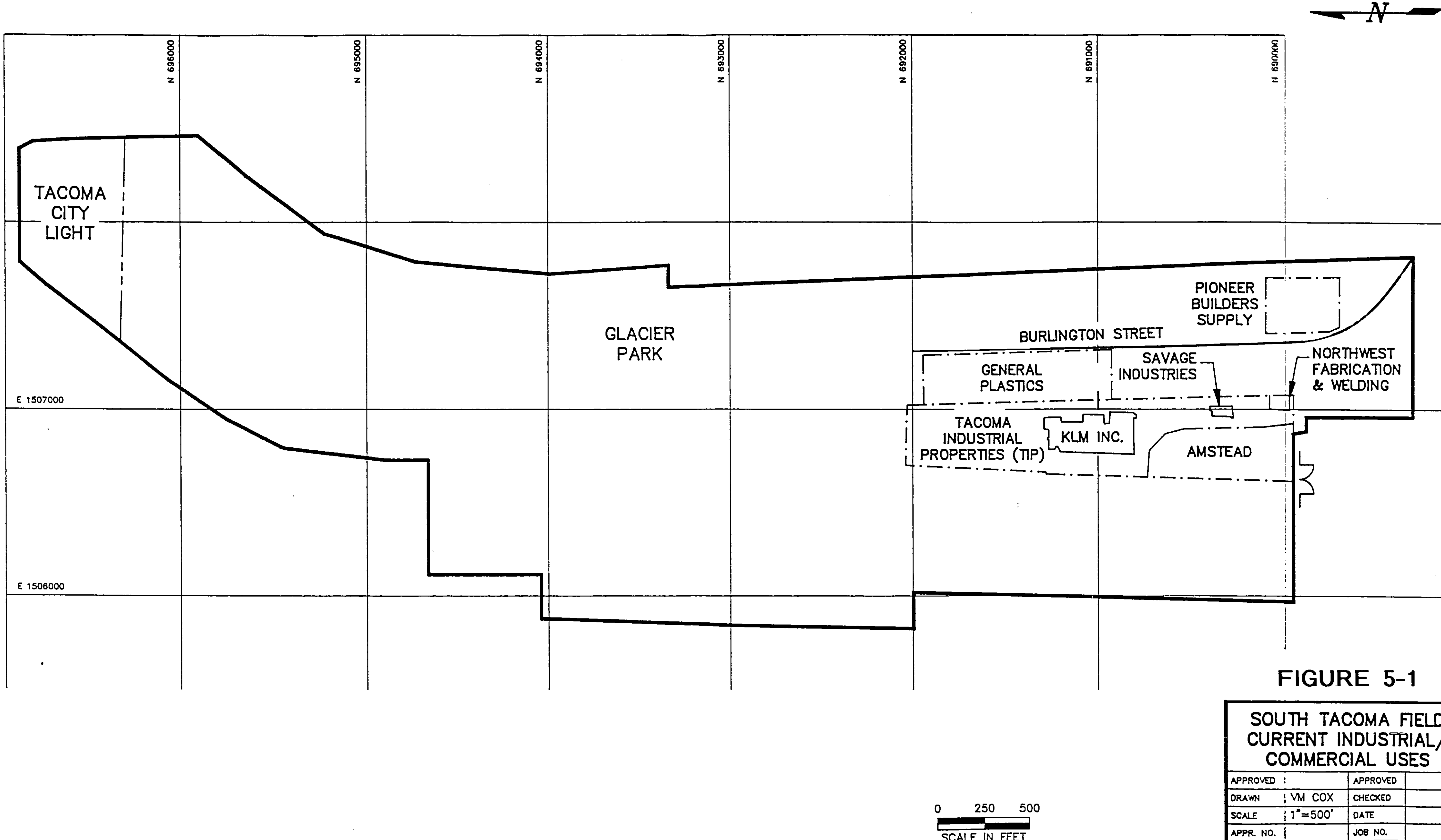


FIGURE 5-1

SOUTH TACOMA FIELD
CURRENT INDUSTRIAL/
COMMERCIAL USES

APPROVED		APPROVED	
DRAWN	VM COX	CHECKED	
SCALE	1"=500'	DATE	
APPR. NO.		JOB NO.	

ICF TECHNOLOGY INCORPORATED
Bellevue, WA

DATE	REVISIONS	BY

Nº STF08.1 DATE: 3/29/90

Base Map Reference
Walker & Assoc. 10-22-86
Surface Debris Sampling Plan
February 1987
For Sitts & Hill Engineers, Inc.
Retec Remediation Technologies, Inc.
South Tacoma Swamp
Taken from Kennedy/Jenks/Chilton
P9SK005-3/22/90

Potential hazardous substances used or stored at the site include chloroflourocarbon (CFC-11), methylene chloride, isocyanates, and polyoles. CFC-11 is used as a blowing agent and is either is contained in the foams, as is the case for rigid foams, or dissipates to the atmosphere through volatilization as a cooling agent. Methylene chloride is used as a cleaning solvent. It is recycled, except for residual sludges which are disposed at a hazardous waste disposal site in Arkansas. Inert materials, such as foam scraps, are disposed of at local landfill operations.

5.1.2 Pioneer Builders

Pioneer Builders purchased a parcel of land in the southeast portion of the STF site from Burlington Northern in 1986. Pioneer Builders built a warehouse and office building on the site and opened for business at this location in 1988. They are a commercial distribution center for cedar and asphalt roofing materials. No products are manufactured at the site.

Fifteen workers are employed by Pioneer Builders. Six employees work full-time at the site in sales, administrative, and loading dock positions. The remainder of the employees deliver roofing materials and are on-site primarily for loading and unloading materials. Customers also visit the property to purchase roofing supplies.

Pioneer Builders currently operates two underground storage tanks. Both tanks are single-walled steel tanks that are less than two years old. One tank has a capacity of 10,000 gallons and is used for storing diesel fuel. The other tank is a 2,000 gallon gasoline tank. In addition, two more abandoned USTs were recently discovered in the northeast corner of their property. The size and use of these tanks is unknown, but Jim Davis, President of Pioneer Builders, stated that he believes they are old fuel oil tanks used to support the railroad yard. Pioneer Builders has contacted Burlington Northern Railroad and the Pierce/Tacoma Health Department regarding removal of these tanks. Pioneer Builders is interested in paving more of their property for parking and storage.

5.1.3 Tacoma Industrial Park

Tacoma Industrial Properties owns property and buildings used for a variety of industrial purposes in the southcentral portion of the site. This property includes the old iron foundry and a few buildings associated with the South Tacoma Car shops. The Griffin Wheel Brass Foundry was once part of TIP, but was resold to Amsted Industries.[1]

Presently, three business operate in the industrial park, Savage Industries, Northwest Welding and Fabrication, and KLM Corporation. Savage Industries has been operating in an old Burlington Northern wood patterns and vaults building since the early 1970s. Savage Industries employs approximately 10 individuals for the manufacture of picture frames. According to Thomas Anderson, President of TIP, Savage Industries utilizes small amounts of paints and no other hazardous substances.

KLM Corporation has operated out of the southern half of the old iron factory since 1986. KLM uses high temperature and pressure to press laminate films onto particle board. These materials are used in the construction of cabinets and interior partitions. KLM employs about five persons at the site.

Northwest Fabrication and Welding has operated out of a building in the southeast portion of the TIP property since 1986. The former use of this building is unknown. Northwest Fabrication has two primary business operations. First, they are a marine dealer. As part of this operation, they repair boats, motors, and trailers. Second, Northwest Fabrication operates a steel fabrication and repair facility.

In addition to the above operations, TIP (or its predecessor Anderson Enterprises) leased space for six other manufacturing operations in recent times. With the exception of Griffin Wheel Company, very little information is currently available about these former operations. The names, dates of operation, and nature of business for former tenants is listed below.

Industrial Benders	To 1974	Steel Tubing, Bending, and Fabrication
Medeira Corp.	To 1987	Lamination of Plastic Overlays on Particle Board
Griffin Wheel Company	To 1980	Railroad Wheel Journey Bearing Foundry
Nu-Tech, Inc.	1978-80	Manufacture of Soil Stabilization Materials

[1] The brass foundry was demolished in 1989. A report summarizing the demolition of this building was prepared by Kennedy/Jenks/Chilton (January 1990). A vacant office building and a small storage building still remain on Amsted's property.

Chem West, Inc.	1980-85	Warehouse
Holland Steel Fabricators	1982-88	Steel Fabrication

5.2 NON-INDUSTRIAL ACTIVITIES

Previous sections of this report summarized past and current industrial uses of the STF site. Because of the undeveloped status of the site, other non-industrial activities that could result in human exposure to contaminants are also known to occur. The purpose of this section is to briefly identify the types of such activities that have been observed, or have been suggested to have occurred, at the site.

Previous discussions with the potentially responsible parties (PRPs) has generally suggested that not many unauthorized activities occur at the site. The most evident exception to this is the continued dumping of domestic and industrial wastes. Fences and barricades that have been erected to prevent continued dumping show blatant evidence of vandalism. Fences and barricades have been removed, cut, bent, and broken in order to gain access to the airport and swamp portions of the site. Piles of fresh domestic wastes are scattered throughout the site. This is particularity true for the western portion of the site (former swamp and airport areas) and the northern portion of the Car Shops site.

Other portions of the site and the corresponding observed or suspected activities taking place on them are listed below:

- The fields north of General Plastics and the old South Tacoma Airport are used to fly remote-controlled model airplanes. The flat and open site presents ideal conditions for such use.
- Abandoned buildings at the site may have been used in recent times as home or base for a local group of adolescents (local gang). In addition, it was suggested that the manufacture and/or use of illegal drugs may have occurred in an abandoned office building located northwest of the former brass foundry.
- Burlington Road, a straight and flat access road to Pioneer Builders and General Plastics, has been nicknamed BIR (Burlington International Raceway) based on reports of unsanctioned drag races on the road.
- The northern and western portion of the site is used as a place to ride motorbikes and all-terrain vehicles (mostly three- and four-wheel recreational vehicles). Evidence of such use is apparent from examination of aerial photographs and from direct observations.
- Portions of the site are allegedly used for parking and privacy by young couples.

- The western edge of the property provides a mixed woodland, wetland, and grassland habitat that provide a diverse habitat for birds. This may encourage use of this portion of the site by bird watchers.

- The abandoned buildings at the site provide opportunities to play and explore by children.

- The City's sanitary sewer system has a distribution system through the property and a pumping station in the northwest corner of the site. On at least two recent occasions, raw sewage has flowed onto the site from the sewer system. It is unknown how frequently personnel from the public works department visit the pumping station or inspect the sewer system on the site.

The degree of other site use by children, such as exploring the fields or playing by the wetlands, is unknown. Several current property managers reported that they did not suspect much use occurs, but trails leading down the ridge along the western edge of the site are readily visible and the possible presence of small bare-foot prints in the wetlands area on the west side of the property suggests that some occurs on a routine basis.

5.3 SITE SECURITY

This section presents information regarding how the various portions of the site have been secured to prevent unauthorized uses of the property and potential exposure to contaminants. Some portions, particularly those areas surrounding active industrial operations, have well-defined security precautions. Tacoma City and Light, General Plastics, and Pioneer Builders all have a fenced security system around their operations that is locked at the end of each working day. Tacoma City and Light employs 24-hour security guards and has installed "electric eyes" along the southern edge of its property. TIP has a gate that is locked at the end of each day that prevents vehicle access to its property. Tom Anderson, President of TIP, indicated that some confusion does occur regarding making sure the gate is locked and yet not locking someone in on the site because several business use the property.

Two more sections of property at the site are fenced and locked to prevent potential exposure to contaminants. The site of the former brass factory, which was demolished in 1989, is secured. In addition, the former clean-out area in the southern portion of the Car Shops area, southwest of Pioneer Builders, has been maintained as a secured fenced area since the discovery and removal of waste drums in this area.

Large portions of the site have either no security precautions or have ineffective security. For example, much of the former Car Shops site, particularly the area north of Pioneer Builders, is accessible from Burlington Street. The cul-de-sac at the end of Burlington Street has been birmmed to discourage vehicle access, but the site is readily accessible by foot. Several fences and barricades exist in the airport portion of the property to discourage further dumping, but excessive vandalism has occurred and much of this area is accessible by vehicle and foot.

6.0 DESCRIPTION OF ON-SITE WASTE CONSTITUENTS

In this section, the available reports prepared regarding the STF site are reviewed and the data contained within those reports evaluated. The data deemed useful for site characterization are then used to develop a preliminary picture of the types and amounts of chemicals present in the area.

6.1 PRELIMINARY EVALUATION OF SITE DATA

Since 1982 many episodes of data collection have occurred at the STF site. In preparation for this report, over thirty-two documents, describing both proposed and completed work, were reviewed. A complete list of documents reviewed is presented in Section 4. Those documents which yielded data relevant to this section are listed in Table 6-1. This section summarizes the data collection events described in those reports, and discusses the quality of the data sets, along with a proposed approach for the handling and use of the data during the RI/FS. Table 6-2 presents a summary of the previous relevant data, the QC documentation of the data, and some information regarding its usefulness.

Several key considerations determined the approach to historical data assessment. The risk of validating past data is that it is very costly, and the end result may be data of known but poor quality, which, due to factors such as parameter and location, may be of limited use. During the course of the RI/FS, data quality and appropriateness will be considered on a use-specific basis by each user.

6.1.1 Summary of Previous Data Collection Events

In October of 1982, under contract to EPA, Black & Veatch collected 10 surface water, 13 groundwater, and 26 subsurface soil samples from the Burlington Northern Property. The samples were analyzed through the Contract Laboratory Program (CLP) for Target Compound List organic and inorganic analytes. These data sets are of the highest level of QC documentation, and presumably have been validated, although validation memos were not part of the report (Black and Veatch, June 1983). If they exist, these memos, as well as disks containing results from the EPA Groundwater Database, will be requested from EPA and entered into the project files. The summarized data, with no validation qualifiers, appear in Appendix

TABLE 6-1

LIST OF REPORTS REVIEWED FOR DATA SUMMARY

Report	ICF File Code No.
Preliminary Site Investigation, South Tacoma Swamp Prepared by Black and Veatch, 6/83	19
Remedial Investigation/Risk Assessment/Feasibility Study: Former Brass Foundry Area, Volumes 1 and 2 Prepared by Kennedy/Jenks/Chilton, 1/87	2 and 3
Investigation/Characterization of the Former Burlington Northern Railroad Parcel, Final Report Prepared by Tacoma-Pierce County Health Department, 4/86	16
Investigation/Surface Waste Removal: Former Iron Foundry Site Prepared by Kennedy/Jenks/Chilton, 5/88	6
Phase 1 Report: Remedial Investigation of South Tacoma Swamp Prepared by ReTec, 5/87	20
Waste Sampling Plan for Surface Debris Mapping at the Burlington Northern Railroad Site, Revision 1 (Includes surface debris sampling plan map from 2/87) Prepared by ReTec, 3/87	4
Soil Sampling and Chemical Testing, Lots 2 and 3 Prepared by AGI, 5/87	5
Expedited Site Characterization: Tacoma Public Utilities South Tacoma Swamp Superfund Site Prepared by Hart Crowser, Inc. 10/89	34

TABLE 6-2 SOUTH TACOMA FIELD DATA SUMMARY

ICF FILE #	SAMPLER	LAB	SAMPLE DATE	TOTAL # SAMPS	MATRIX	TYPE	LOCATION	PAGE
#19	B&V	CLP LABS	10/82	10	SURFACE WATER	grab	BN PROP	TABLE 1
	B&V	CLP LABS	10/82	13	GROUNDWATER	grab	BN PROP	
	B&V	CLP LABS	10/82	26	SUBSURFACE SOIL	grab	BN PROP	
#2&3	BENLAB	BENLAB	UNDATED	3	SOIL	composite	FORMER	APPENDIX K
#16	TPCHD	WEYERHAUSER	12/85	6	SURFACE SOIL	grab	BNR	APPENDIX 3.0
	TPCHD	WEYERHAUSER	12/85	2	SURFACE SOIL	composite	RAILYARD	
	TPCHD	WEYERHAUSER	12/85&1/86	2	SUBSURFACE SOIL	grab		
#3	B&V	CLP LABS	6/85	13	GROUNDWATER	grab	BN PROP	APPENDIX N
#3	EARTH CONS.	BENNET LABS	2/85, ANAL. 9/85		SUBSURF.SOIL/FILL/SLAG	?	FORMER BRASS	#3, APPENDIX L,M
#3	EARTH CONS.	BENNET LABS	2/85	30	SUBSURF.SOIL/FILL/SLAG	?	FOUNDRY	#3, APPENDIX L,M
#3	EARTH CONS.	BENNET LABS	8/86	22	MATERIAL RESIDUES/DUST		FORMER BRASS FOUNDRY	#3, APPENDIX P
#2&3	KJC	KJC LAB	9/86	4	SURFACE SOIL	grab	FORMER	APPENDIX C
#2&3	KJC	KJC LAB	9/86	7	GROUNDWATER	grab	BRASS	APPENDIX C
#2&3	KJC	KJC LAB	9/86	17	SUBSURFACE SOIL	grab	FOUNDRY	APPENDIX C
#2&3	BENNET LAB	KJC LAB	2/85	8	SUBSURFACE SOIL	?		APPENDIX C
#6	KJC	KJC LAB	10/2/86	2	SURFACE SOIL	grab	FORMER	APPENDIX C
#6	KJC	KJC LAB	10/9/86,	2	STORM DRAIN WATER	grab	IRON	
#6	KJC	KJC LAB	10/10/86	5	STORM DRAIN SED.	grab	FOUNDRY	
#6	KJC	KJC LAB	11/11/87	3	SUBSURFACE SOIL	grab		
#6	KJC	KJC LAB	09/26/86	3	GROUNDWATER	grab		
#6	KJC	KJC LAB	11/12/87	1	GROUNDWATER	grab		
#20&4	RETEC	E.C.S. - (FIELD LAB)	1/87	49	SURFACE DEBRIS	grab	BNR PROP	SHEET 1B
#20&4	RETEC	LAUCKS	2/12/87	11	SURFACE DEBRIS	grab	BNR PROP	SHEET 1A
#20&4	RETEC	LAUCKS	3/10/87- 3/12/87	21	SURFACE DEBRIS	composite	500'GRID	SHEET 1A
#5	AGI	ANALYT. TECHNOL.	4/23/87	8	SUBSURFACE SOIL	composite	BNR RAILYARD	ATTACHMENT II
	HART CROW.	HART CROWSER	9/26/89	19	SEDIMENT	grab	TACOMA PUB.	APPENDIX A
	HART CROW.	MOBILE LAB	9/28/89	4	SEDIMENT	grab	UTILITIES	APPENDIX A
	HART CROW.	" "	9/28/89	17	SOIL	grab		APPENDIX A
	HART CROW.	SOUND ANALYT.	9/28/90	6	SOIL	grab		APPENDIX A

TABLE 6-2 SOUTH TACOMA FIELD DATA SUMMARY

ICF FILE #	SAMPLER	LAB	SAMPLE DATE	TOTAL # SAMPS	MATRIX	PAHs 8310 (# SAMPS)	METALS (# SAMPS)	EP TOX W/METALS (# SAMPS)	TPH (# SAMPS)	VOA FIELD SCREEN. (# SAMPS)
#19	B&V	CLP LABS	10/82	10	SURFACE WATER		10(CLP INORG)			
	B&V	CLP LABS	10/82	13	GROUNDWATER		13(CLP INORG)			
	B&V	CLP LABS	10/82	26	SUBSURFACE SOIL		26(CLP INORG)			
#2&3	BENLAB	BENLAB	UNDATED	3	SOIL		3(44 METS)			
#16	TPCHD	WEYERHAUSER	12/85	6	SURFACE SOIL	6	6(8METS)	6(3METS)		
	TPCHD	WEYERHAUSER	12/85	2	SURFACE SOIL	2?				
	TPCHD	WEYERHAUSER	12/85&1/86	2	SUBSURFACE SOIL		2(8METS)	2(3METS)		
#3	B&V	CLP LABS	6/85	13	GROUNDWATER		13(CLP INORG)	-		
#3	EARTH CONS.	BENNET LABS	2/85, ANAL. 9/85		SUBSURF.SOIL/FILL/SLAG			12(6 METS)		
#3	EARTH CONS.	BENNET LABS	2/85	30	SUBSURF.SOIL/FILL/SLAG		30(Pb),27(As)			
#3	EARTH CONS.	BENNET LABS	8/86	22	MATERIAL RESIDUES/DUST		22(Pb),10(7 METS)			
#2&3	KJC	KJC LAB	9/86	4	SURFACE SOIL		4(Pb),1(11 METS)	1(4 METS)		
#2&3	KJC	KJC LAB	9/86	7	GROUNDWATER		7(Cd,Pb),1(Cd,Zn)			
#2&3	KJC	KJC LAB	9/86	17	SUBSURFACE SOIL		9(Pb),1(Cu,Cd,Zn)	1(4 METS)		
#2&3	BENNET LAB	KJC LAB	2/85	8	SUBSURFACE SOIL		8(Pb),3(Cu,Cd,Zn) Pb			
#6	KJC	KJC LAB	10/2/86	2	SURFACE SOIL					
#6	KJC	KJC LAB	10/9/86,	2	STORM DRAIN WATER		2(Pb)			
#6	KJC	KJC LAB	10/10/86	5	STORM DRAIN SED.		5(Pb)	1(Pb)	2	
#6	KJC	KJC LAB	11/11/87	3	SUBSURFACE SOIL					
#6	KJC	KJC LAB	09/26/86	3	GROUNDWATER		3(Cu,Pb)			
#6	KJC	KJC LAB	11/12/87	1	GROUNDWATER					
#20&4	RETEC	E.C.S. - (FIELD LAB)	1/87	49	SURFACE DEBRIS					49
#20&4	RETEC	LAUCKS	2/12/87	11	SURFACE DEBRIS		11(12 METS)			
#20&4	RETEC	LAUCKS	3/10/87-3/12/87	21	SURFACE DEBRIS		21(12 METS)			
#5	AGI	ANALYT. TECHNOL.	4/23/87	8	SUBSURFACE SOIL	8	8(7 METS)	8		
	HART CROW.	HART CROWSER	9/26/89	19	SEDIMENT					
	HART CROW.	MOBILE LAB	9/28/89	4	SEDIMENT					
	HART CROW.	" "	9/28/89	17	SOIL					
	HART CROW.	SOUND ANALYT.	9/28/90	6	SOIL		1(Pb)			

TABLE 6-2 SOUTH TACOMA FIELD DATA SUMMARY

ICF FILE #	SAMPLER	LAB	SAMPLE DATE	TOTAL # SAMPS	MATRIX	PCBs 8080 (# SAMPS)	VOAs 8020 (602) (# SAMPS)	VOAs 8240 (# SAMPS)	VOAs FIELD HEADSPACE	BNAs 8270 (# SAMPS)
#19	B&V	CLP LABS	10/82	10	SURFACE WATER	10(CLP ORG)		10(CLP ORG)		10(CLP ORG)
	B&V	CLP LABS	10/82	13	GROUNDWATER	13(CLP ORG)		13(CLP ORG)		13(CLP ORG)
	B&V	CLP LABS	10/82	26	SUBSURFACE SOIL	26(CLP ORG)		26(CLP ORG)		26(CLP ORG)
#2&3	BENLAB	BENLAB	UNDATED	3	SOIL					
#16	TPCHD	WEYERHAUSER	12/85	6	SURFACE SOIL					
	TPCHD	WEYERHAUSER	12/85	2	SURFACE SOIL	2				
	TPCHD	WEYERHAUSER	12/85&1/86	2	SUBSURFACE SOIL	2				2
#3	B&V	CLP LABS	6/85	13	GROUNDWATER	13(CLP ORG)		13(CLP ORG)		13(CLP ORG)
#3	EARTH CONS.	BENNET LABS	2/85, ANAL. 9/85		SUBSURF.SOIL/FILL/SLAG					
#3	EARTH CONS.	BENNET LABS	2/85	30	SUBSURF.SOIL/FILL/SLAG					
#3	EARTH CONS.	BENNET LABS	8/86	22	MATERIAL RESIDUES/DUST					
#2&3	KJC	KJC LAB	9/86	4	SURFACE SOIL					
#2&3	KJC	KJC LAB	9/86	7	GROUNDWATER		1			
#2&3	KJC	KJC LAB	9/86	17	SUBSURFACE SOIL		3			
#2&3	BENNET LAB	KJC LAB	2/85	8	SUBSURFACE SOIL					
#6	KJC	KJC LAB	10/2/86	2	SURFACE SOIL	1				1
#6	KJC	KJC LAB	10/9/86,	2	STORM DRAIN WATER					
#6	KJC	KJC LAB	10/10/86	5	STORM DRAIN SED.					
#6	KJC	KJC LAB	11/11/87	3	SUBSURFACE SOIL		1	2		1
#6	KJC	KJC LAB	09/26/86	3	GROUNDWATER					
#6	KJC	KJC LAB	11/12/87	1	GROUNDWATER			1		
#20&4	RETEC	E.C.S. - (FIELD LAB)	1/87	49	SURFACE DEBRIS					
#20&4	RETEC	LAUCKS	2/12/87	11	SURFACE DEBRIS			11		11
#20&4	RETEC	LAUCKS	3/10/87-3/12/87	21	SURFACE DEBRIS			21		21
#5	AGI	ANALYT. TECHNOL.	4/23/87	8	SUBSURFACE SOIL	8				
	HART CROW.	HART CROWSER	9/26/89	19	SEDIMENT	19(MODIFIED 8080)			21	
	HART CROW.	MOBILE LAB	9/28/89	4	SEDIMENT					
	HART CROW.	" "	9/28/89	17	SOIL					
	HART CROW.	SOUND ANALYT.	9/28/90	6	SOIL	6	5	5		

TABLE 6-2 SOUTH TACOMA FIELD DATA SUMMARY

ICF FILE #	SAMPLER	LAB	SAMPLE DATE	TOTAL # SAMPS	MATRIX	G&O (# SAMPS)	HALOCARB. (8010?) (# SAMPS)	FISH BIOASSAY (# SAMPS)	MISC. (# SAMPS)
#19	B&V	CLP LABS	10/82	10	SURFACE WATER				
	B&V	CLP LABS	10/82	13	GROUNDWATER				
	B&V	CLP LABS	10/82	26	SUBSURFACE SOIL				
#2&3	BENLAB	BENLAB	UNDATED	3	SOIL				
#16	TPCHD	WEYERHAUSER	12/85	6	SURFACE SOIL			1	6 (TOC, TOX)
	TPCHD	WEYERHAUSER	12/85	2	SURFACE SOIL				
	TPCHD	WEYERHAUSER	12/85&1/86	2	SUBSURFACE SOIL		2	2	2 (TOC, TOX)
#3	B&V	CLP LABS	6/85	13	GROUNDWATER				
#3	EARTH CONS.	BENNET LABS	2/85, ANAL. 9/85		SUBSURF.SOIL/FILL/SLAG				
#3	EARTH CONS.	BENNET LABS	2/85	30	SUBSURF.SOIL/FILL/SLAG				
#3	EARTH CONS.	BENNET LABS	8/86	22	MATERIAL RESIDUES/DUST				22(ASBESTOS BY PCOM)
#2&3	KJC	KJC LAB	9/86	4	SURFACE SOIL				1(PHENOLS,S--,CN-)
#2&3	KJC	KJC LAB	9/86	7	GROUNDWATER				
#2&3	KJC	KJC LAB	9/86	17	SUBSURFACE SOIL	4			4 (TOC)
#2&3	BENNET LAB	KJC LAB	2/85	8	SUBSURFACE SOIL				
#6	KJC	KJC LAB	10/2/86	2	SURFACE SOIL				
#6	KJC	KJC LAB	10/9/86,	2	STORM DRAIN WATER				
#6	KJC	KJC LAB	10/10/86	5	STORM DRAIN SED.				
#6	KJC	KJC LAB	11/11/87	3	SUBSURFACE SOIL				
#6	KJC	KJC LAB	09/26/86	3	GROUNDWATER				
#6	KJC	KJC LAB	11/12/87	1	GROUNDWATER				
#20&4	RETEC	E.C.S. - (FIELD LAB)	1/87	49	SURFACE DEBRIS				
#20&4	RETEC	LAUCKS	2/12/87	11	SURFACE DEBRIS				
#20&4	RETEC	LAUCKS	3/10/87-3/12/87	21	SURFACE DEBRIS				
#5	AGI	ANALYT. TECHNOL.	4/23/87	8	SUBSURFACE SOIL				
	HART CROW.	HART CROWSER	9/26/89	19	SEDIMENT				21 (PAHs,8100)
	HART CROW.	MOBILE LAB	9/28/89	4	SEDIMENT				
	HART CROW.	" "	9/28/89	17	SOIL				
	HART CROW.	SOUND ANALYT.	9/28/90	6	SOIL				

TABLE 6-2 SOUTH TACOMA FIELD DATA SUMMARY

ICF FILE #	SAMPLER	LAB	SAMPLE DATE	TOTAL # SAMPS	MATRIX	QA/QC: QC PRESENT	QA/QC: QC COMMENTS	QA/QC: SUGGESTED DATA USE
#19	B&V	CLP LABS	10/82	10	SURFACE WATER	CLP DATA, BUT NO QC PRESENT; UNCLEAR WHETHER OR NOT DATA WAS VALIDATED	CLP DATA; VALIDATION MEMOS TO BE REQUESTED FROM EPA, IF THEY EXIST. NO QUALIFIERS APPEAR IN SUMMARY TABLES IN DOCUMENT	DATA SHOULD BE USEABLE FOR MOST PURPOSES INCLUDING RISK ASSESSMENT
	B&V	CLP LABS	10/82	13	GROUNDWATER			
	B&V	CLP LABS	10/82	26	SUBSURFACE SOIL			
#2&3	BENLAB	BENLAB	UNDATED	3	SOIL	NO QC PRESENT		
#16	TPCHD	WEYERHAUSER	12/85	6	SURFACE SOIL	NO QC PRESENT		DATA IS SUITABLE FOR SITE CHARACTERIZATION; PROBABLY NOT WORTH OBTAINING QC
	TPCHD	WEYERHAUSER	12/85	2	SURFACE SOIL			
	TPCHD	WEYERHAUSER	12/85&1/86	2	SUBSURFACE SOIL	NO QC PRESENT		
#3	B&V	CLP LABS	6/85	13	GROUNDWATER	ALL LAB QC PRESENT	CLP DATA, VALIDATION MEMO IN REPORT ICF FILE #3, APP.N	DATA, AS QUALIFIED SHOULD BE SUITABLE FOR RISK ASSESSMENT
#3	EARTH CONS.	BENNET LABS	2/85, ANAL. 9/85		SUBSURF.SOIL/FILL/SLAG	NO QC PRESENT		DATA IS SUITABLE FOR SITE CHARACTERIZATION
#3	EARTH CONS.	BENNET LABS	2/85	30	SUBSURF.SOIL/FILL/SLAG	NO QC PRESENT		DATA IS SUITABLE FOR SITE CHARACTERIZATION
#3	EARTH CONS.	BENNET LABS	8/86	22	MATERIAL RESIDUES/DUST	NO QC PRESENT		DATA NOT RELEVANT
#2&3	KJC	KJC LAB	9/86	4	SURFACE SOIL	NO QC PRESENT		DATA IS SUITABLE FOR SITE CHARACTERIZATION; PROBABLY NOT WORTH OBTAINING QC
#2&3	KJC	KJC LAB	9/86	7	GROUNDWATER			
#2&3	KJC	KJC LAB	9/86	17	SUBSURFACE SOIL			
#2&3	BENNET LAB	KJC LAB	2/85	8	SUBSURFACE SOIL			
#6	KJC	KJC LAB	10/2/86	2	SURFACE SOIL	VOA SURROGATES & METHOD BLANKS, CHAIN OF CUSTODY	FEW SAMPLES, FEW PARAMETERS; UNCLEAR WHICH PCB AROCHLOR DETECTED	DATA SUITABLE FOR SITE CHARACTERIZATION ONLY BECAUSE FEW SAMPLES AND FEW PARAMETERS
#6	KJC	KJC LAB	10/9/86,	2	STORM DRAIN WATER			
#6	KJC	KJC LAB	10/10/86	5	STORM DRAIN SED.			
#6	KJC	KJC LAB	11/11/87	3	SUBSURFACE SOIL			
#6	KJC	KJC LAB	09/26/86	3	GROUNDWATER			
#6	KJC	KJC LAB	11/12/87	1	GROUNDWATER			
#20&4	RETEC	E.C.S. (FIELD LAB)	1/87	49	SURFACE DEBRIS	LAB BLANKS, MS,MSD,COCS, FIELD REPS, TICS	DATA IS OF CLP QUALITY & CLP DOCUMENTATION; ALL QC PRESENT; BUT UNCLEAR WHETHER DATA WAS VALIDATED OR NOT; NO QUALIFIERS APPEAR IN SUMMARY TABLES IN REPORT	DATA SHOULD BE SUITABLE FOR MOST PURPOSES, EXCEPT COMPOSITES PROBABLY ARE NOT USEABLE FOR RISK ASSESSMENT
#20&4	RETEC	LAUCKS	2/12/87	11	SURFACE DEBRIS			
#20&4	RETEC	LAUCKS	3/10/87-3/12/87	21	SURFACE DEBRIS			
#5	AGI	ANALYT. TECHNOL.	4/23/87	8	SUBSURFACE SOIL	FIELD & METHOD BLANKS, CHAIN OF CUSTODY	COMPOSITED SAMPLES OF LIMITED USE	DATA SUITABLE FOR SITE CHARACTERIZATION
	HART CROW.	HART CROWSER	9/26/89	19	SEDIMENT	MATRIX SPIKES, MATRIX SPIKE DUPLICATES, BLANKS, CONTROL LIMITS	SCREENING METHOD; ESTIMATED RESULTS, TENTATIVE IDENTIFICATIONS	DATA SUITABLE FOR SITE CHARACTERIZATION; DATA COMPARES FAIRLY WELL WITH CONFIRM. SAMPLES, (BELOW)
	HART CROW.	MOBILE LAB	9/28/89	4	SEDIMENT			
	HART CROW.	" "	9/28/89	17	SOIL			
	HART CROW.	SOUND ANALYT.	9/28/90	6	SOIL	DUPLICATES		DATA SUITABLE FOR SITE CHARACTERIZATION;

A of this report. These data should be suitable for many different uses due to the level of QA and QC documentation, the large number of target parameters, and the location and nature of media sampled.

In June of 1985 Black & Veatch resampled the groundwater for Target Compound List (TCL) organic and inorganic analytes through the CLP. The validation memo appears in Appendix N of the Kennedy/Jenks/Chilton RI/FS document (January 1987). The summarized data appear in Appendix A of this report. Like the data collected by Black & Veatch in 1982, these data should be suitable for many different uses as noted above.

At an undocumented date, presumably some time in 1985, Bennett Laboratories collected three soil samples from the parking lot next to the Former Brass Foundry and analyzed them for metals by an ICP scan. No QC or sample location information is present in the report in which these data appear as Appendix K, (Kennedy/Jenks/Chilton (K/J/C), January 1987). As a result of this lack of information, the data are judged unsuitable for all uses.

In December of 1985 the Tacoma-Pierce County Health Department (TPCHD) performed sampling of surface and subsurface soil at a former Burlington Northern (B/N) railcar repair/demolition facility located on the STF site. The samples were analyzed by Weyerhauser Technology Center Analytical Laboratories located in Tacoma, Washington. Although the analytical methods and modifications to those methods are described in the Appendix 3.0 of the report (Tacoma-Pierce County Health Department, April 1986), no QC is reported. Because of the lack of QC, and due to the small number of samples (eight surface soils and two subsurface soils), an after the fact validation of the data does not seem warranted at this time. The data, as reported, are judged to be suitable for site characterization and project planning.

In February of 1985 and August of 1986, Earth Consultants, in conjunction with Bennett Laboratories, sample soils, including fill and slag materials (30 total samples) for purposes of resource evaluation at the former Brass and Iron Foundry area. Parameters and analytical methods are tabularized in Table 6-2. No QC information is available in the published report (K/J/C January 1987).

In August of 1986, Bennett Laboratories sampled material residues and dust from in and around the building formerly occupied by the Griffin Wheel Company on the former Brass Foundry area of the STF site. The 22 samples were analyzed for metals and asbestos. No QC information is available with the data which were reported in Appendix P of the K/J/C report (K/J/C, January 1987). However, these data are not considered relevant since removal action was carried out by the property owners between November 1989 and February 1990.

In September of 1986, K/J/C, under contract with the property owners, conducted several sampling events at the former Brass & Iron Foundry area of the STF site. Surface and subsurface soils were sampled and analyzed by K/J/C's Laboratory Division for a variety of analytes. Also analyzed were subsurface soil samples collected by Bennett Laboratories in February of 1985. QC information was not published in the report (K/J/C, January 1987).

Between October of 1986 and November of 1987, KJC collected samples of surface soil, storm drain water and sediment, subsurface soil and groundwater from the former Brass & Iron Foundry area. Some QC information, including surrogates and method blanks for the volatile organic analysis, and chain of custody forms, was reported for the analyses. However, due to the small number of parameters and samples, and considering the lack of clarity of the report, the data probably are of limited use. For example, PCBs are reported as Aroclor 3540, which is, apparently, a reporting error.

Between January and March of 1987, Remedial Technologies, under contract to the Burlington Northern Railroad, sampled surface "debris" from a 500' grid located at the Burlington Northern Property for full TCL organic and inorganic parameters. The samples were analyzed by Laucks using CLP protocols for analysis and documentation. These data should be suitable for some uses, and much QC information is available in the report (Remedial Technologies, May 1987). However, it is unclear whether the data have been validated. No data qualifiers appear on the summary tables of the data in that report. In addition, 21 of the 32 total samples were composited, therefore the use of the results is limited.

In April of 1987, Applied Geotechnology, Inc., under contract to Pioneer Builders Supply Company, collected eight composited subsurface soil samples from part of the Burlington Northern Property. The samples were analyzed by Analytical Technologies for several parameters. No QC information appears in the report. The data are suitable for some uses such as site characterization. However, composited data are of limited use for risk assessments.

In October of 1989, Hart Crowser, Inc., under contract to Tacoma Public Utilities, collected sediment samples from dry wells, and soil samples from the Tacoma Public Utilities property on the STF site. The samples were analyzed by field screening methods for PCBs and Volatile Organic Compounds

(VOCs). QC information, including matrix spikes, matrix spike duplicates, blanks, and the control limits imposed by the laboratory, are available in the report (Hart Crowser, October 1989). Six of the samples were sent to Sound Analytical for confirmation analysis. The data are suitable for some purposes including site characterization and possible remedial purposes. However, identifications are tentative, and results are quantitatively estimated. Therefore, the data are of limited use for risk assessment. The correlation between the field screening data and the confirmatory results is fairly good. However, no QC information is presented in that report for the confirmatory results except duplicates with no detected concentrations reported. Therefore, an assessment of the quality of the confirmatory data is not possible.

6.2 OVERVIEW OF SITE DATA

In this section, we summarize the data obtained from previous site investigations. The documents reviewed as part of this data summary are those listed in Table 6-1.

The data gleaned from the reports listed in Table 6-1 are presented in Appendix A (Tables A1 through A4). The tables of data have been broken out into different media to facilitate interpretation. In addition, because of the plethora of soil data available, we have further segregated the soil data into inorganics and organics. Table A1 of Appendix A contains inorganic data for soils while Table A2 provides organic soil data. Data obtained from site debris are included in the tables reserved for soil data.

Analytical data for groundwaters (Appendix A, Table A3) were separated from surface water data (Appendix A, Table A4) to provide easier identification of those constituents that may have migrated to the groundwater.

The tables provided in Appendix A represent a data reduction when compared to the data presented in the reports. That is, not all of the data found in the various reports were included in Tables A1 to A4 of Appendix A. Data that were below the quantitation limit of the methodology and instrument for that particular analyses were excluded. Moreover, some of the data have not been used because the areas from which the samples were taken no longer exist. For example, Kennedy/Jenks/Chilton (1990) describe samples taken from a building on the property of Amsted Industries, Inc. This building has recently been demolished and removed from the site. Therefore, the data that resulted from samples taken in the building were not included in the tables.

Figure 6-1 presents a summary of the potential contaminants that have been identified in the sampling conducted to date. The map does not imply that these are the only constituents of concern that may be present at the site. Nor does the map imply anything about the quality of the data. The map merely summarizes the analyses performed to data without comment on the completeness of the data or the level of confidence in the analyses and the sampling. The map further makes no statement as to the significance of the concentrations of the constituents that are reported on the map. Figure 6-1 is not all inclusive as far as the constituents that are reported. Figure 6-1 is meant to provide an overview of the types of potential contamination that have been identified at the site. The constituents identified in the previous sampling trips are discussed in the following paragraphs. The discussion is a summary of information that is contained on Figure 6-1 and in Appendix A (Tables A1 to A4). The constituents found in soils are discussed first followed by a discussion of constituents found in groundwaters and surface waters.

6.2.1 Soils

Lead is the most pervasive constituent identified in the sampling and analyses conducted to date. Lead has been found from the southern to the northern portions of the site and from the eastern boundary to areas located in the western half of the site (Figure 6-1 and Appendix A). The lead identified in the northern portion of the site is located adjacent to and immediately south of the property owned by Tacoma City Light (dismantling yard). Lead has been found in well over 100 soil samples. The concentrations of lead found in the soils range from less than 1 mg/kg (ppm) to 150,000 mg/kg. Higher concentrations of lead were found on the Amsted property near the former brass foundry, at the rail dismantling yard, and at the freight repair and maintenance shops.

Chromium has been found at the northern portion of the site in relatively high concentrations. Chromium has also been identified along the western boundary and at the southern end of the site. Compared to the number of samples in which lead has been found, chromium has been detected in relatively few samples. Chromium appeared in over 30 soil samples. Chromium concentrations found in the soils ranged from 1.2 to 642 mg/kg. Higher concentrations appeared in the dismantling area and at the industrial dump site.

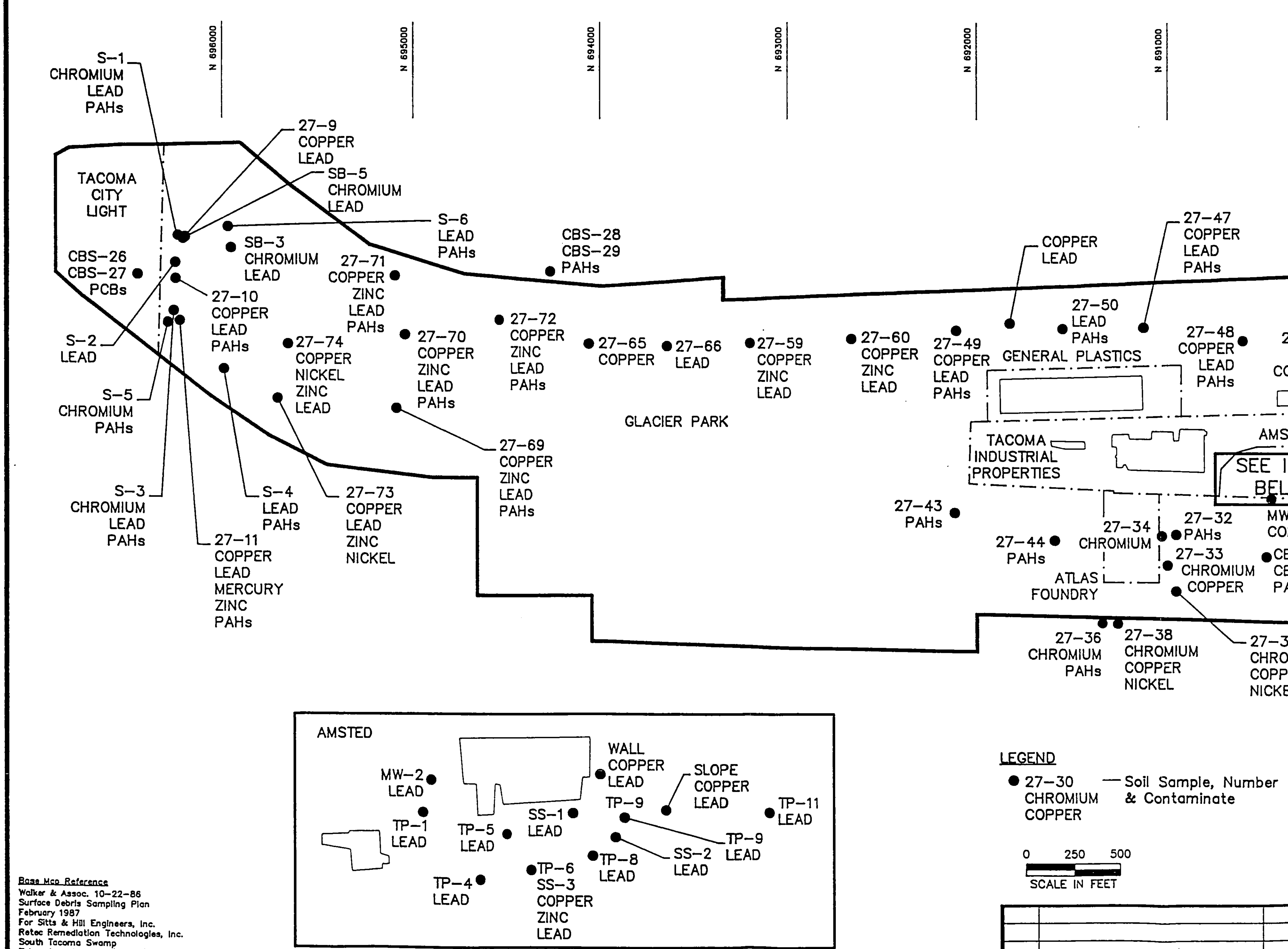


FIGURE 6-1

SOUTH TACOMA FIELD
OVERVIEW OF SITE CONTAMINATION

APPROVED		APPROVED	
DRAWN	VM COX	CHECKED	
SCALE	1"=500'	DATE	
APPR. NO.		JOB NO.	

ICF TECHNOLOGY INCORPORATED
Bellevue, WA

DATE	REVISIONS	BY

NO STF11.2 DATE: 4/9/90

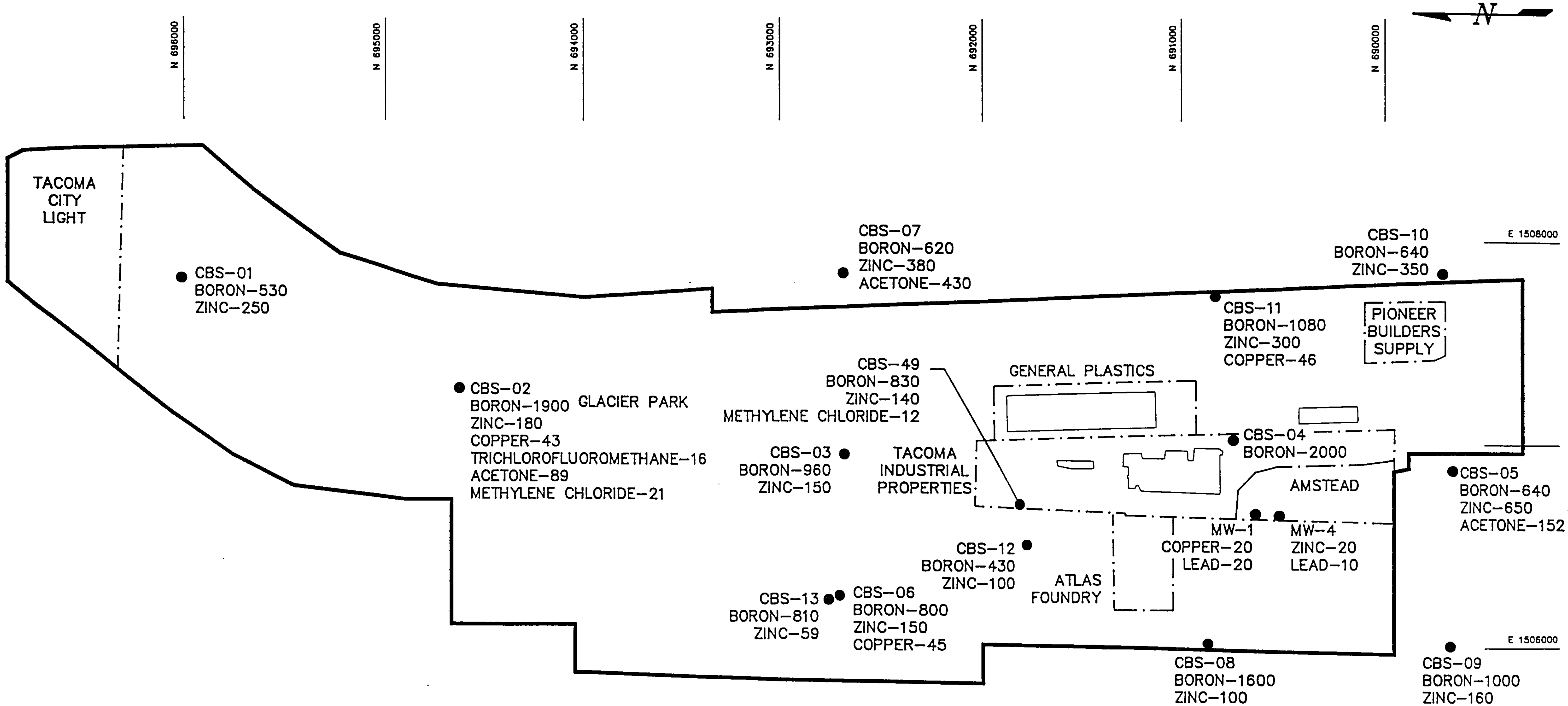


FIGURE 6-2

LEGEND

● CBS-07 LEAD-120 — Groundwater Sample, Number & Concentration in ppb

0 250 500
SCALE IN FEET

DATE	REVISIONS	BY	

SOUTH TACOMA FIELD
GROUNDWATER SAMPLES

APPROVED		APPROVED	
DRAWN	VM COX	CHECKED	
SCALE	1"=500'	DATE	
APPR. NO.		JOB NO.	

ICF TECHNOLOGY INCORPORATED
Bellevue, WA

Nº	STF12.2	DATE: 4/9/90

Base Map Reference
Walker & Assoc. 10-22-86
Surface Debris Sampling Plan
February 1987
For Sitts & Hill Engineers, Inc.
Retec Remediation Technologies, Inc.
South Tacoma Swamp
Taken from Kennedy/Jenks/Chilton
P9SK005-3/22/90

Copper has been detected in the southern, central, and northern areas of the site. Copper was identified in over 30 samples. Copper concentrations ranged from a low of 5.4 mg/kg to a high of 410,000 mg/kg. High concentrations of copper were found in the dismantling area, the repair and maintenance shops, and the former general industrial dump site. High concentrations of copper are particularly evident in the vicinity of the Amsted property. The surface soils south of the area where the former Brass Foundry was located have a green hue from high copper concentrations.

Zinc has been found in over soil 50 samples in locations throughout the site. Concentrations of zinc were determined to range from 1.9 mg/kg to 140,000 mg/kg. The highest soil concentrations of zinc (140,000 mg/kg) have been found on the Amsted property. Lesser concentrations of zinc have been found in the dismantling yard and the repair and maintenance area. With the exception of the elevated concentrations of zinc found at the Amsted property, soil concentrations of zinc are generally below 1,000 mg/kg.

Arsenic appeared in over 50 soil samples and has been identified at soil concentrations of less than 10 mg/kg throughout the site. However, one sample from the foundry parking lot had a concentration of 130 mg/kg. Moreover, concentrations of arsenic above 10 mg/kg have been found in the dismantling area.

Antimony has been detected in a limited number of samples with concentrations ranging from 3.6 to 2100 mg/kg. A high concentration of antimony (2100 ppm) was found at the foundry parking lot. Values of 180 mg/kg and 230 mg/kg were found in the dismantling area on the property immediately south of the land owned by Tacoma City Light. Antimony also appeared near the old airport, at the industrial dump site, at the repair and maintenance area, and in the southern portion of the site.

Detectable quantities of nickel appeared in approximately 20 samples. Nickel concentrations varied from less than 5 mg/kg to 740 mg/kg. Higher concentrations of zinc are located at the industrial dump site, the dismantling areas, and on the Amsted property near the former brass foundry.

Beryllium was found in 25 samples with the concentrations ranging from 0.2 to 0.9 mg/kg. The soil samples with the highest concentrations of beryllium are located at the repair and maintenance area.

The concentrations of cadmium, in the approximately 30 soil samples where cadmium was detected, varied from 0.2 to 19 mg/kg. The highest concentration of cadmium (19 mg/kg) was located at the foundry parking lot. High concentrations (13 mg/kg) were also identified in the area immediately south of Tacoma City Light. Lower concentrations were found at the industrial dump site and toward the north end of the former airport.

Mercury concentrations varied from 0.1 to 12 mg/kg with the highest concentration (12 mg/kg) found at the north end of the site on the property south of and adjacent to the Tacoma City Light property (dismantling area).

Selenium concentrations ranged from 0.8 to 3.5 mg/kg. The high concentration of selenium was located at the industrial dump site.

Silver was detected in a limited number of samples at concentrations up to 2 mg/kg. The highest concentrations of silver appeared at the industrial dump site.

Tin appeared in one sample and vanadium in two samples. The high vanadium value was 5.0 mg/kg while the tin value was 2.8 mg/kg.

Soil concentrations of polynuclear aromatic hydrocarbons (PAHs) as high as 1.4 and 1.9 percent have been identified at well CBS-04. Polynuclear Aromatic Hydrocarbons have been found elsewhere on-site. In fact, PAHs have been identified in all general areas (north, south, east, and west) of the STF site.

Several soil samples had detectable quantities of PCBs. Most of the samples were taken from the property of Tacoma City Light. The concentrations found at Tacoma City Light ranged up to 620 mg/kg. The only sample containing PCBs, not found on the property of Tacoma City Light, was found at the southern extreme of the site and had a concentration of less than 1 ppb.

Trichlorofluoromethane was found in roughly 20 soil samples. The concentrations found varied from 2.1 to 14 ug/kg (ppb).

Detectable quantities of naphthalene were found in approximately 10 soil samples with a high value of 7600 mg/kg.

Additional organics were detected in soil samples: Benzene (up to 3 mg/kg), total xylenes (up to 13 mg/kg), trichloroethane (high of 19 mg/kg), phenol (up to 1900 mg/kg), and benzoic acid. A complete list of organic compounds identified in the soil sampling can be found in the data tables (Appendix A).

6.2.2 Groundwaters and Surface Waters

Boron was detected in groundwater samples taken at different locations throughout the site (Figures 6-2 and 6-3). For example, the presence of boron has been found in all the CBS wells. The concentrations of boron found in the CBS wells range from 0.11 to 2.0 mg/l.

Groundwater concentrations of iron were highly variable. Iron concentrations as high as 17.5 mg/l were found in the CBS wells. Iron values in the CBS wells below the detection limits were also found.

Manganese concentrations in samples taken from the groundwater at the CBS wells had concentrations that ranged from below detection limits (15 ppb) to 1.4 mg/l. Manganese has been detected in samples taken in wells from the southern to the northern areas of the site.

Zinc appeared in over 30 groundwater and surface water samples. The detection limit was 10 ppb and the observed concentrations ranged from 12 to 650 ppb.

Nitrate has been detected in all of the wells labeled CBS-01 through CBS-13. Ammonia has been detected in most of the CBS wells (CBS-01 through CBS-13). Nitrate concentrations in the CBS wells ranged from 0.03 to 5.3 mg/l. The highest ammonia concentration was 1.76 mg/l in CBS-06.

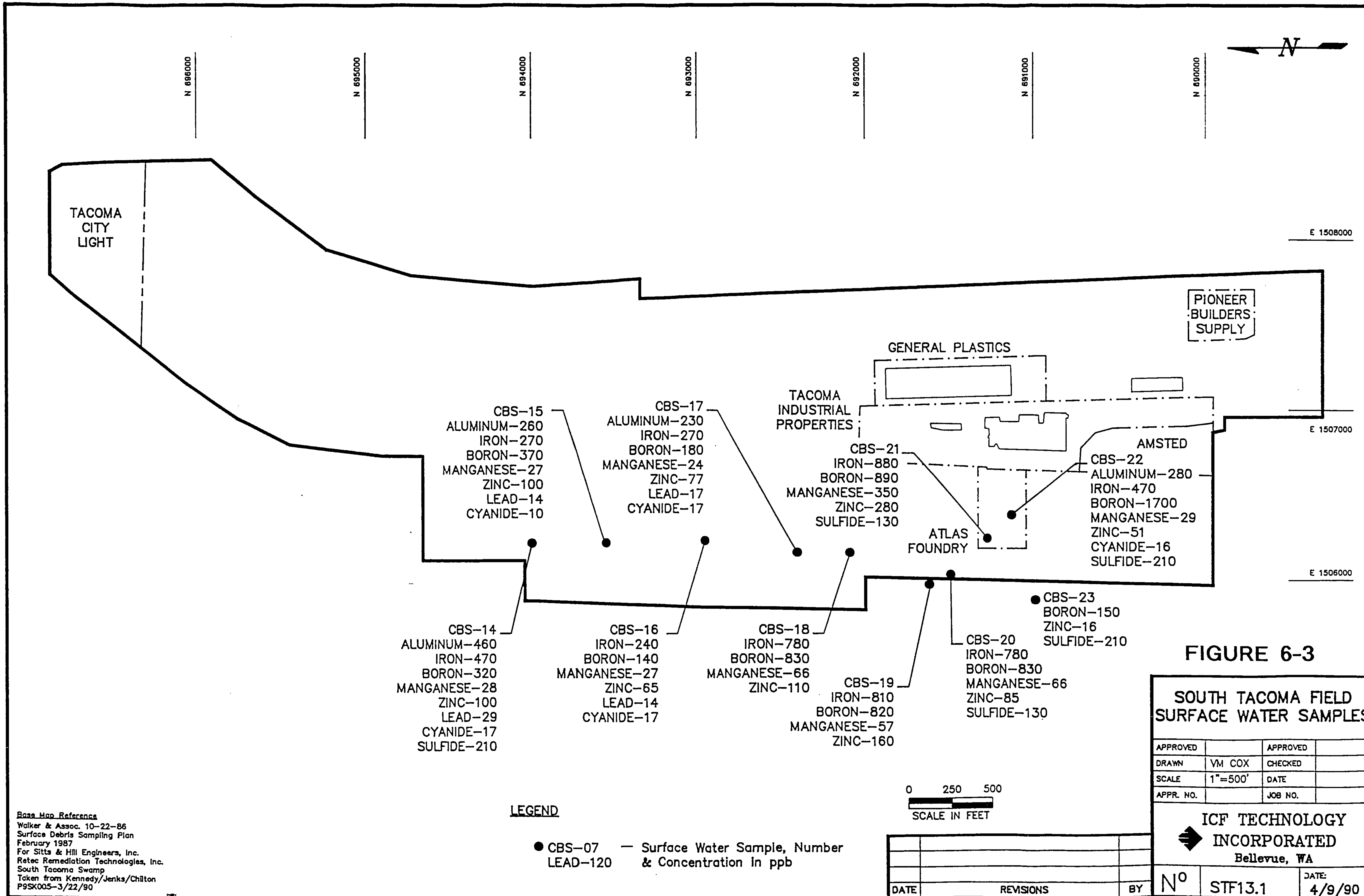


FIGURE 6-3

SOUTH TACOMA FIELD SURFACE WATER SAMPLES

Arsenic was detected in a sample from CBS-08 at a concentration of 18 ppb. No other detectable quantities of arsenic were reported in groundwaters or surface waters.

Other inorganics reported in the groundwaters and surface waters were cadmium (three samples above 1 ppb detection limit at 1.6, 6.5 and 14 ppb), sulfide (ranging from below the 50 ppb detection limit to 210 ppb), cyanide (highest sample contained 210 ppb in surface water), and barium (detected in five samples, highest value was 490 ppb).

Lead concentrations up to 30 ppb in groundwaters and 29 ppb in surface waters exist. The high lead value (30 ppb) was found in a sample taken from CBS-12. Values of 20 ppb have been found in groundwaters at the northern and southern areas of the site.

Four groundwater samples had detectable quantities of mercury. The concentrations ranged from 0.62 to 1.2 ppb. The detection limit was 0.2 ppb. The high value (1.2) was detected at CBS-13.

A volatile organic, trichlorofluoromethane, was found above the quantitation limit at 16 ppb in CBS-02. Another volatile compound, methylene chloride, was found in two wells (CBS-01 and CBS-49) at 21 and 12 ppb, respectively. Methylene chloride was also detected in laboratory blanks indicating that the detectable methylene chloride may be due to laboratory contamination. Methylene chloride is a solvent that is used routinely in the laboratory. Acetone was detected in several samples and also in laboratory blanks. The high acetone found in the samples was 430 ppb. Acetone is another solvent commonly used in the laboratory and was used by Black and Veatch (1983) to decontaminate field equipment. Naphthalene was detected (28 ppb) in the groundwater only in samples taken from CBS-08.

7.0 POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS

This section presents a preliminary analysis of the potential human health and environmental effects resulting from the contamination present at the STF site. A conceptual site model and diagram were developed as part of this process and are presented in Figures 7-1 and 7-2. The conceptual site model was developed based upon the known type and extent of environmental contaminants present at the site and the past and present industrial operations that have occurred there. Major aspects of the model are discussed in this section.

The remainder of this section is organized as follows. Section 7.1 summarizes the sources of chemical release. Section 7.2 identifies the type and extent of known contamination. Section 7.3 presents a summary of the potential for transport of contaminants. Preliminary assessments of the potential human health and ecological impacts from site contaminants are presented is Sections 7.4 and 7.5, respectively. Lastly, Section 7.6 identifies data needs for these risk assessments.

7.1 SOURCES OF CHEMICAL RELEASE

The contamination present at the STF site is likely to be the result of the variety of activities that have occurred at the site over the past 100 years. These activities included the manufacture, assembly, disassembly, and disposal of railroad car parts which required the use of several foundries and industrial buildings. Disposal activities have allegedly occurred at a variety of dump areas and burn pits. Also present at the site was an airfield at which airplane maintenance and refueling operations occurred. An electric utility is located on one end of the site and the storage of transformers and other utility operations may be the source of some of the PCBs found in the area.

Throughout the history of the site a variety filling and numerous illegal dumping events have been noted. Material was brought in to fill the lake, swamp, and wetland areas probably to improve drainage and add more buildable land. In the thirties and forties, portions of the swamp were reportedly used as a municipal waste dumping area and evidence of illegal dumping of primarily domestic garbage continues to be present at the site today.

FIGURE 7-1

CONCEPTUAL SITE MODEL

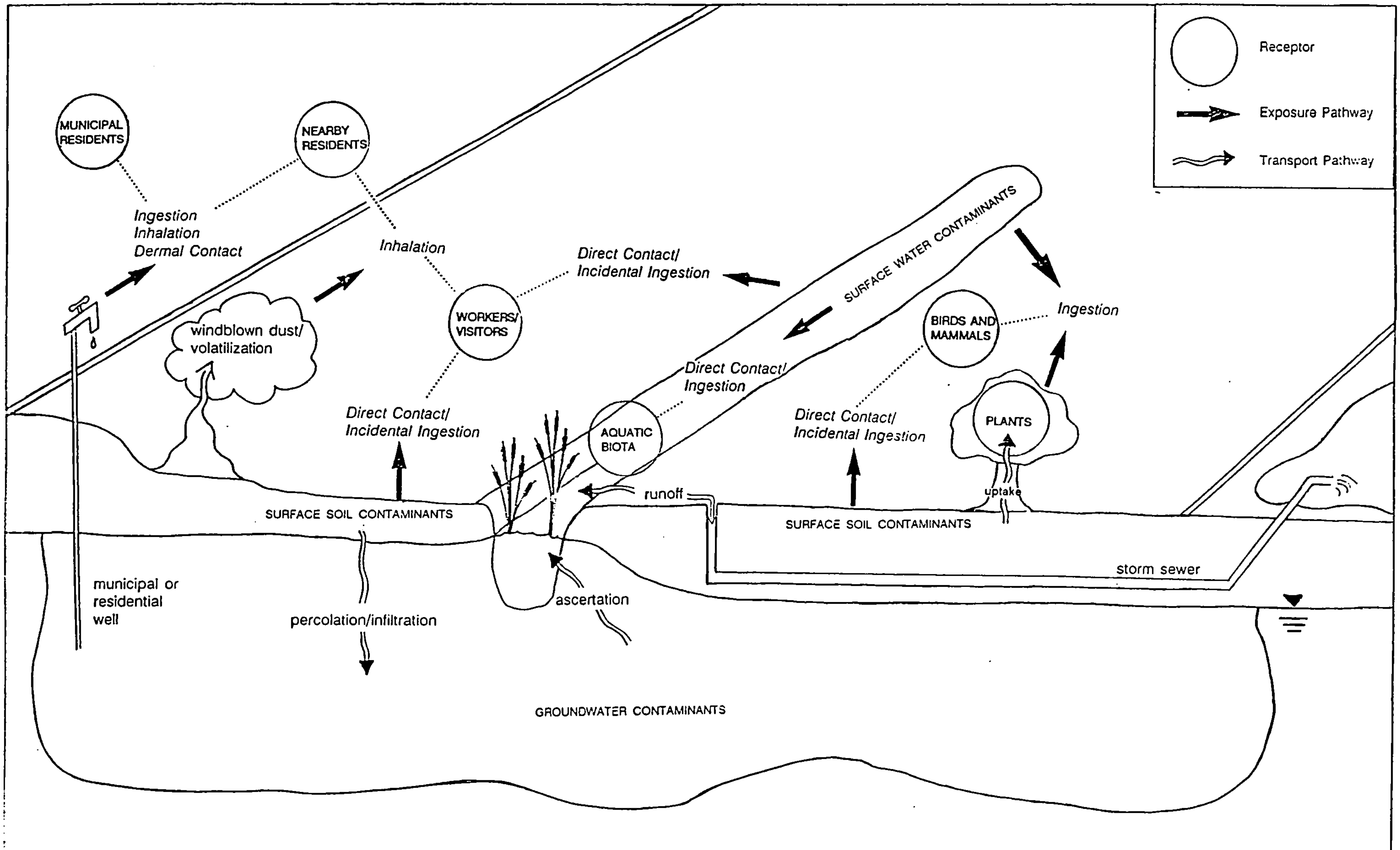
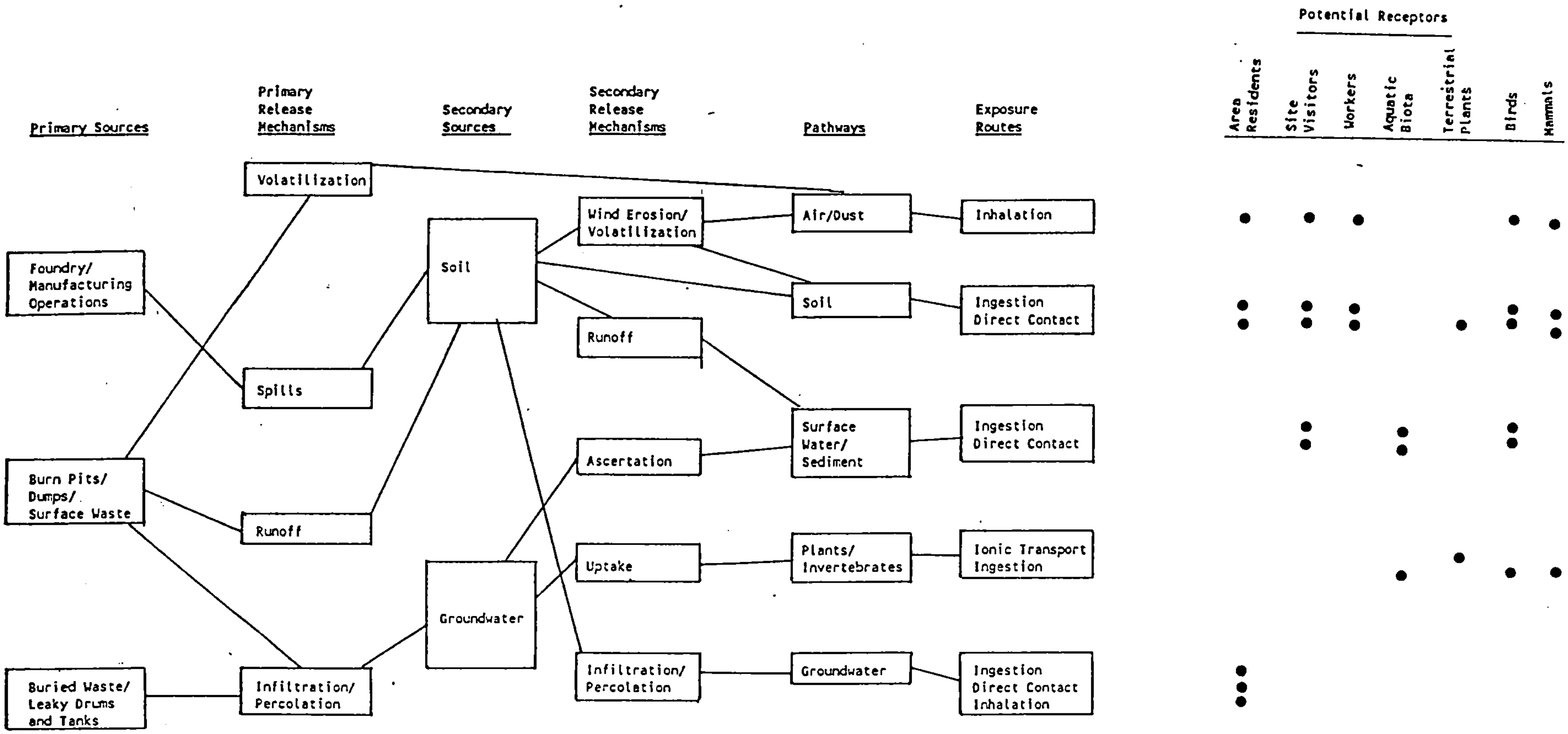


FIGURE 7-2

CONCEPTUAL SITE DIAGRAM



7.2 KNOWN OR SUSPECTED CONTAMINATION

This section paraphrases information presented in Section 6.0 - Description of On-Site Waste Constituents. More detailed information about site sampling and results can be found in that section.

7.2.1 Soil

A variety of metals and other contaminants have been found across the site at concentrations exceeding those commonly found in soils across the U.S. and presumably in the area surrounding the STF site. A summary of the range of contaminants found and a comparison of these values to common background soil levels is found below.

Chemical	Range Found On-Site (ppm)	Concentrations Commonly Found In Normal Soils (ppm)
Beryllium	<02. - 0.9	0.1 - 40
Cadmium	<.2 - 19	0.01 - 7
Chromium	1 - 642	5 - 3,000
Copper	<1 - 410,000	2 - 100
Lead	<1 - 150,000	2 - 200
Mercury	<.1 - 12	.01 - .08
Nickel	<5 - 740	5 - 1000
PAHs	ND - 19,000	
PCBs	<1 ppb - 620 ppm	
Zinc	<2 - 140,000	10 - 300

7.2.2 Groundwater

Groundwater has been sampled at thirteen locations scattered across the site. Boron has been reported to be present in water taken from all of the wells and varies in concentration from 110 to 2000 ppb. Concentrations of boron commonly found in waters across the U.S. range from 20-1000 ppb. It is unclear, however, what the local background concentration of boron is for the STF area and whether the concentrations of boron found on-site represent elevated levels.

Also reported in the water taken from several of the wells were arsenic, copper, lead, mercury, and zinc. All of the arsenic, lead, and mercury concentrations were below their MCLs of 30, 50, and 2 ppb, respectively; the zinc and copper concentrations were below their SMCLs of 5000 and 1000 ppb, respectively. Manganese was detected at levels up to 1400 ppb.

Acetone and methylene chloride were detected at low concentrations in a few of the wells. These chemicals were also found in laboratory blanks and it is possible that these chemicals are present as a result of lab contamination. Trichlorofluoromethane was detected at 16 ppb in one well.

7.2.3 Surface Water

Samples of surface water have been taken at ten locations spanning the western edge of the STF site. The results of the sampling are summarized below and are compared to Ambient Water Quality Criteria where available.

Chemical	Range (ppb)	Ambient Water Quality Criteria[a] (ppb)	Number of Locations Exceeding Criteria
Aluminum	230 - 460	--	
Boron	140 - 1700	--	
Cyanide	10 - 17	5.2	5
Iron	240 - 880	1000	0
Lead	14 - 17	3.2[b]	4
Manganese	24 - 350		
Sulfide	130 - 210	2	4
Zinc	16 - 280	1000[b]	0

[a] Fresh chronic criteria.
[b] Hardness dependent criteria.

7.3 ENVIRONMENTAL TRANSPORT MEDIA

Currently contaminants are found primarily in the soils and surface waters of the STF site. Soil contaminants may be transported to other locations by a number of means. First, wind may potentially spread dustborne and volatilized contaminants to on-site and locations. Second, surface runoff may carry suspended soil particles and dissolved contaminants into surface wetlands located along the western edge of the property or into the storm sewer system, which empties into Commencement Bay. Third, rainwater may aid in the infiltration or percolation of the contaminants to the groundwater table. Contaminants reaching the groundwater could then migrate laterally to distant locations. Groundwater ascertation potentially may cause contaminants to resurface . Fourth, biological uptake can allow contaminants to move up into and through the food chain.

7.4 HUMAN HEALTH ASSESSMENT

7.4.1 Identification of Human Exposure Points and Routes

Under the current conditions at the STF site, persons might contact the contaminants at a number of locations and be exposed to the chemicals in a number of ways. Contaminants have been detected in soils throughout the site. Persons working or visiting at the site may be exposed to the contaminants by direct contact with soils or dust while performing their work duties. They may incidentally ingest soils or dusts from their hands during activities such as eating or smoking. They may also inhale the contamination if the wind or activities such as driving trucks across dirt roads should cause the contaminants to become airborne. If contaminated dust should be blown , it is possible that nearby residents may inhale airborne chemicals. If the dust should settle in their gardens, it may be possible to have some exposure via ingestion of homegrown fruits or vegetables.

Contaminants have also been found in the surface waters of the site. Site visitors such as children from the nearby residences may be exposed through direct contact or incidental ingestion of the surface water if they came to play at the creek.

Some chemicals have been found in the groundwater under the site, although it is unclear at this time whether the concentrations represent elevated levels. It is believed that no one at this time on the STF site is using groundwater as a drinking water source, and consequently, that no one is being exposed to contaminants through the ingestion of drinking water. However, there is a potential for site usage to be changed in the future and (even in the absence of site usage changes) for migration of groundwater contaminants to municipal water sources. Consequently, ingestion of drinking water may be a potential future exposure pathway.

In summary, the following human exposure pathways have been selected for consideration at the STF site:

Potential Exposure Pathways under Current Conditions

- Inhalation of volatilized or windborne contaminants by workers and visitors on-site or by residents at adjacent locations.

- Direct contact and incidental ingestion of soil contaminants by workers and visitors on-site or by residents at adjacent locations.

- Ingestion of contaminants in homegrown foods grown by nearby residents in contaminated soils.

- Direct contact and incidental ingestion of surface water by site visitors playing in creek.

Additional Potential Exposure Pathways under Future Conditions

- Ingestion, dermal contact, and inhalation of volatilized contaminants from groundwater used as a drinking water sources.

7.4.2 Discussion of Potential Human Health Impacts

__Soils__. A number of chemicals have been found in on-site soils including the inorganic chemicals: chromium, copper, lead, mercury, nickel, zinc, and others; and the organic chemicals: PAHs and PCBs. [Many of these are at quite high concentrations (see Table 7-1). As an example, lead has been found as high as 150,000 ppm, well in excess of EPA's Interim Soil Cleanup Level for lead of 500 to 1000 ppm.] These chemicals are known to cause a variety of noncancer health effects. Additionally, lead, some PAHs and PCBs, hexavalent chromium by inhalation, and some nickel compounds by inhalation are known or probable human carcinogens. Persons at or near the STF site may be experiencing exposure to these contaminants at concentrations that may result in adverse health effects over time through direct contact, incidental ingestion, or inhalation of contaminants in soils or windblown.

__Groundwater__. Several chemicals including arsenic, boron, copper, lead, manganese, and zinc have been found in the groundwater underneath the STF site. Groundwater under this site is not currently being used as a source of drinking water and consequently this route of exposure at the current time does not appear to be a health threat. However, in the future the potential exists for the installation of a drinking water well on-site or the migration of contaminants to a nearby residential or municipal water well. If the contaminant levels were to remain at their current concentrations, it is unlikely that this exposure would be of a concern because arsenic, copper, lead, mercury, and zinc are believed to be present below their respective MCLs or SMCLs and based on the EPA reference dose for boron and manganese, an adult can consume 2 liters of water containing 0.28 mg/L boron or 7 mg/L manganese per day for a lifetime. Ammonia has also been detected at levels below its organoleptic standard of 34 mg/L. However, because it is possible for more contaminants to infiltrate to the groundwater, this pathway may be of a concern for future exposures.

Surface Water. Of the chemicals found in surface waters, iron, lead, manganese, and zinc are present at concentrations below or close to their respective drinking water MCLs or SMCLs and therefore are not likely to pose a threat to humans exposed through dermal contact and incidental ingestion. Based upon EPA reference doses, boron and cyanide are also not suspected to be of concern. Aluminum and sulfide are found in concentrations also not likely to be of concern via dermal contact.

7.5 ECOLOGICAL ASSESSMENT

Ionic uptake, soil ingestion, and surface runoff are potential important release mechanisms for inorganic metals. Although inorganic metals do not tend to bioaccumulate, very high localized concentrations may lead to elevated concentrations in plants through ionic uptake. The presence of several trees on the property with large portions of plant death suggests that significant levels of ionic uptake of contaminants may presently be occurring in some portions of the site. Elevated metals concentrations in plants can lead to significant exposure to vertebrates.

Ingestion of soil bound contaminants may have significant impacts to birds, reptiles, and mammals that feed on invertebrates or vegetation associated with the ground. Exposure may result from direct ingestion of soil (e.g., deliberate ingestion of grit by birds or accidental ingestion of soil particles on or around invertebrates and vegetation) or from indirect means, such as elevated concentrations in worms. Soil ingestion of contaminants by birds may represent one of the larger current ecological effects that occur at the site.

Surface runoff typically contains high levels of suspended particulate matter. Because surface soils have high concentrations of inorganic metals, these metals may be readily transported from the site via surface runoff. Surface runoff may enter on-site wetlands or run into the City's storm sewers, where it is diluted prior to discharge into Commencement Bay. Inorganic metals may accumulate in bottom sediments and wetlands and lower their biological productivity. NOAA has initiated actions to minimize discharge of environmental contaminants into the Puget Sound via storm sewer systems. Both of these transport mechanisms need to be evaluated. If the level of current potential contaminant transport through surface runoff is determined to be significant, then potential aquatic receptors need be identified and potential impacts assessed.

Constituents of petroleum products, cleaning solvents, and paints, and, to a lessor extent, inorganic metals can be leached from contaminated soils to dissolve in groundwater. Except where groundwaters reach the surface or near-surface areas, ecological risks from such environmental contaminants that percolate to the groundwater table are generally low compared to public health risks. The nature and extent of groundwater contamination at the site, and the hydrogeological conditions, will be evaluated in conjunction with the public health risk assessment. In addition to investigations required to meet the requirements of the public health risk assessment, the potential for contaminated groundwaters to reach surface waters, particularly Flett and Leach Creeks, must be investigated because of their importance to salmon populations. The former South Tacoma Swamp used to extend down to the headwaters area of Flett Creek. The current hydrologic connections between subsurface waters, on-site wetlands, and surface streams is unknown.

With the exception of PCBs, the contaminants identified at the STF site do not tend to bioaccumulate. PCB contamination is known to be present under the pavement at the Tacoma City Light Plant. The extent of PCB contamination and its potential to enter the food chain must be evaluated.

7.6 DATA NEEDS ASSOCIATED WITH THE RISK ASSESSMENT

7.6.1 Data Needs for the Human Health Risk Assessment

There are several important data needs for the risk assessment. First, it is important for the suspected contaminants to determine the background concentrations of these chemicals that are naturally occurring in the surrounding soils and waters. Second, additional information needs to be collected to more fully characterize the types and extent of contamination across the site. Thirdly, it is important to determine the potential for the contaminants to migrate to locations. For soils, in addition to contaminant concentrations, it is important to know the particle size distribution. This information assists in assessing the degree to which the contaminants, particularly those that are carcinogens by the inhalation route, may be taken in by the inhalation of windblown dust and/or transported . Additional information that may assist in the assessment of transport of dust by wind includes information about meteorological parameters of the area and the extent of traffic and other dust generating activities on the site. For soils, it is also important to determine the potential for the contaminants to infiltrate to groundwater and to be carried to locations where they may occur in drinking water. In addition to the knowledge of the characteristics of the contaminants themselves, information necessary for this assessment consists of information about the soils such as organic carbon content and hydraulic conductivity.

7.6.2 **Data Needs for the Ecological Risk Assessment**

An ecological risk assessment can not be adequately performed without a more precise inventory of the plants, animals, wetlands, and drainage patterns that are associated with the site. Wetlands and surface drainage surveys must identify location, type, and condition, of these features, as well as hydraulic connections to surface and subsurface waters (particularly Flett and Leach Creeks).

Vegetation surveys need to specifically search for Arenaria paludirola, a candidate species for Federal endangered species classification. The vegetation survey should also identify other wetland and terrestrial plants that are an important source of food to birds and mammals that utilize the site.

The site and the adjacent woodland property to the west of the site should be inventoried for birds. Knowledge of the species of birds that utilize the site (which includes ducks, pheasants, hawks, and songbirds) will be important to identify ecological sensitive species.

The horizontal distribution and vertical depth of contaminants in surface and near-surface soils needs to be documented. Concentrations of contaminants need to be determined in on-site surface waters and bottom sediments of the wetlands.

PCBs tend to bioaccumulate in the food chain more than other contaminants identified at the site. PCB sampling needs to document whether open pathways exist between contaminants and biota.

8.0 PRELIMINARY IDENTIFICATION OF ARARs

Congress mandated, in Section 121 (d) of the 1986 Superfund Amendments and Reauthorization Act (SARA), that site cleanups conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), comply with the requirements of all federal and duly promulgated state environmental and public health laws. These laws are known in the Superfund program as Applicable or Relevant and Appropriate Requirements (ARARs).

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

"Applicability" implies that the remedial action or the circumstance at the site satisfy all of the jurisdictional prerequisites of a requirement. For example, the minimum technology requirement for surface impoundments under Resource Conservation and Recovery Act (RCRA) would apply if a new hazardous waste surface impoundment were to be built on the South Tacoma Field site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. However, in some circumstances a requirements may be relevant, but not appropriate, for the site-specific situation.

The relevance and appropriateness of a requirement can be judged by comparing a number of factors, including the characteristics of the remedial action, the hazardous substances in question, or the physical circumstances of the site, with those addressed in the requirement. For example, since RCRA does not have jurisdiction over hazardous waste which were generated and managed before November 19, 1980, the RCRA capping requirements are not applicable to such wastes which are closed in-place. However, the requirements may be relevant and appropriate.

A requirement that is judged to be relevant and appropriate must be complied with to the same degree as if it were applicable. Moreover, remedial actions must comply with a relevant and appropriate requirement that is more stringent than an applicable requirement. If, for example, a State standard is "applicable" while a more stringent federal standard is "relevant and appropriate," the more stringent federal standard will govern. However, there is more direction in the determination of relevance and appropriateness. It is possible for portions of a requirement to be considered relevant and appropriate, while the rest may be dismissed as irrelevant.

In addition to legally binding laws and regulation, many federal and state environmental and public health programs also develop criteria, advisories, guidance, and proposed standards that are not legally binding, but that may provide useful information or recommended procedures. These materials are evaluated, along with ARARs, as part of the risk assessment conducted for each CERCLA site, to establish protective cleanup level targets, and to help identify remedial action alternatives.

8.1 CATEGORIES OF ARARs

ARARs have been divided into three categories. They are:

- Chemical-specific ARARs,
- Location-specific ARARs, and
- Action-specific ARARs.

These terms are described below.

Chemical-specific ARARs include those laws and requirements which regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied.

Location-specific ARARs are those requirements which relate to the geographical or physical position of the site, rather than the nature of the contaminants or the proposed site remedial actions. These requirements may limit the type of remedial actions which can be implemented, and may impose additional constraints on the cleanup action.

Action-specific ARARs are requirements which define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restriction on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Because there are usually several alternative actions for any remedial site, very different requirements can come into play. The action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

8.2 CHEMICAL-SPECIFIC ARARs AND TBCs

Chemical-specific potential ARARs for water:

- RCRA Maximum Concentration Limit (MCL),
- SDWA Maximum Contaminant Level (MCL),
- CWA Ambient Water Quality Criteria for Protection of Aquatic Life, and
- SDWA Maximum Contaminant Level Goals (MCLGs).

As summarized above, the major regulations which contribute to the list of potential chemical-specific ARARs are the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and the Resource Conservation and Recovery Act (RCRA).

The RCRA and SDWA Maximum Contaminant Level (MCL) standards are based on human consumption of water for drinking, cooking, bathing, etc. Economic considerations and technical feasibility of treatment processes are included in the justification for these levels. These are enforceable standards which may be applicable to the discharge of any liquid to surface water or groundwater which can be classified as a source or potential source of drinking water. In general, the SDWA and RCRA MCLs will be relevant and appropriate to the discharge of liquids to surface water (since it is not a direct source of public drinking water), and applicable to the discharge of liquids into groundwater, or to a direct source of drinking water. The MCLs may also be applicable to any other action which affects the concentration of contaminants in groundwater.

The Maximum Contaminant Level Goals (MCLGs) are not promulgated, enforceable requirements and, therefore, are To Be Considered (TBCs), not ARARs. The MCGLs are health-based standards that do not take into account the cost or implementability of treatment. They are goals for the nation's water supply systems which represent the concentration at which there is no risk to human health. The MCGLs are included in SARA Section 121 as ARARs. However, since, by definition, MCLs are protective of human health and the environment, EPA classifies MCLs as ARARs, and MCLGs as TBCs. The MCLGs, along with other TBCs, may be used when multiple compounds or exposure pathways cause the MCLs to be less than fully protective.

The CWA Ambient Water Quality Criteria (AWQC) are designed to protect aquatic life (both marine and freshwater). These standards are expressed on the bases of acute and chronic toxicity levels. and on-site discharges to surface water, may be required to meet these criteria.

8.3 LOCATION-SPECIFIC ARARs

Table 8-1 includes the location-specific requirements currently identified as potential ARARs for CERCLA remedial actions. Location-specific ARARs differ from chemical-specific or action-specific ARARs in that they are not closely related to the characteristics of the wastes at the site, or to the specific remedial alternative under consideration. Location-specific ARARs are concerned with the area in which the site is located. Actions may be required to preserve or protect aspects of the environment or cultural resources of the area which may be threatened by the existence of the site, or by the remedial actions to be undertaken at the site.

The major regulations which form the list of potential location-specific ARARs include RCRA, the National Archaeological and Historic preservation Act, the National Historic Preservation Act, the Endangered Species Act, the Clean Water Act, the Wilderness Act, the Fish and Wildlife Coordination Act, the Scenic Rivers Act, the Coastal Zone Management Act, the Marine Protection Resources and Sanctuary Act, the Executive Orders on the Protection of Woodlands, and the Protection of Floodplains.

8.4 ACTION-SPECIFIC ARARs

Because action-specific ARARs are requirements which define acceptable treatment and disposal procedures for hazardous substance, the action-specific ARARs applicable to the South Tacoma Field

TABLE 8-1

POTENTIAL LOCATION-SPECIFIC ARARs FOR THE STF SITE

Location	Requirement	Prerequisite(s)	Citation
1. Within 61 meters (200 ft) of a fault displaced in Holocene time	New treatment, storage, or disposal of hazardous waste prohibited	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18 (a)
2. Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(b)
3. Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood prone areas	Executive Order 11988, Protection of Floodplains, (40 CFR 6, Appendix A)
4. Within salt dome formation, underground mine, or cave	Placement of noncontainerized or bulk liquid hazardous waste prohibited	RCRA hazardous waste; placement	40 CFR 264.18 (c)
5. Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data	National Archaeological and Historical Preservation Act (16 U.S.C. Section 469) 36 CFR Part 65
6. Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks	Property included in or eligible for the National Register of Historic Places	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 36 CFR Part 800
7. Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior	Determination of endangered species or threatened species	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402

TABLE 8-1

(Continued)

Location	Requirement	Prerequisite(s)	Citation
8. Wetland	Action to minimize the destruction, loss, or degradation of wetlands	Wetland as defined by Executive Order 11990 Section 7	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A)
	Action to prohibit discharge of dredged or fill material into wetland without permit		Clean Water Act Section 404; 40 CFR Parts 230, 231
9. Wilderness area	Area must be administered in such manner as will leave it unimpaired as wilderness and to preserve its wilderness character	Federally owned area designated as wilderness area	Wilderness Act (16 US 1131 et seq.); 50 CFR 35.1 et seq.
10. Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd(c) may be undertaken in areas that are a part of the National Wildlife Refuge System	Area designated as part of National Wildlife Refuge System	16 USC 668 dd et seq.; 50 CFR Part 27
11. Area affecting stream or river modifies a stream or river	Action to protect fish or wildlife (16 U.S.CC. 661 et seq.); 40 CFR	Diversion, channeling, or other and affects fish or wildlife	Fish and Wildlife Coordination activity 6.302
12. Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river	Activities that affect or may affect any of the rivers specified in Section 1276(a)	Scenic Rivers Act (16 U.S.C. 1271 et seq. Section 7 (a)); 40 CFR 6.302(e)
13. Within coastal zone	Conduct activities in manner consistent with approved State management programs	Activities affecting the coastal zone including lands thereunder and adjacent shorelands	Coastal Zone Management Act (16 U.S.C. Section 1451 et seq.)
14. Oceans or waters of the United States	Action to dispose of dredge and fill material into ocean waters is prohibited without a permit	Oceans and waters of the United States Sar ·tuary Act Section 103	Clean Water Act Section 404 40 CFR 125 Subpart M; Marine Protection Resources and

(STF) Superfund Site are addressed in Section 9.0. Section 9.0 contains a preliminary identification of remedial alternatives that may be applicable to the STF site.

8.5 STATE ARARS

There are five criteria which define state ARARs. In order to be considered as ARARs, the requirements must be:

1. Promulgated standards,
2. More stringent than federal requirements,
3. Identified to EPA in a timely manner,
4. Not result in a statewide prohibition on land disposal, and
5. Consistently applied statewide.

It is EPA's policy that State ARARs will be achieved to the greatest extent practicable.

Glynis A. Carrosine of The Washington State Department of Ecology (DOE) made a preliminary list of Washington State Regulations that may be applicable to the STF site. The regulations compiled hy t' Department of Ecology are listed below.

8.5.1 Hazardous Waste Laws

Model Toxics Control Act (Init. 97)

Section 3

Ecology is required to give preference to "permanent solutions to the maximum extent practicable and shall provide for or require adequate monitoring to ensure the effectiveness of the remedial action."

Minimum cleanup standards for remedial actions must be "at least as stringent as the cleanup standards under Section 121 of the federal cleanup law, 42 U.S. C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law."

Section 9

Under state law, the definition of "hazardous substance" includes petroleum products. This law, enacted for the remediation of hazardous waste sites, is clearly applicable.

Hazardous Waste Management (RCW 70.105)

This is the enabling legislation empowering Ecology to assert authority in hazardous waste management. This law deals with the handling and disposal of hazardous waste so it is applicable in all aspects of the remediation, wherever hazardous waste is found.

8.5.2 Water Quality Laws

Water Pollution Control Act (RCW 90.48)

This law authorizes the use of water quality regulations at hazardous waste sites. This law requires all known and available treatment of discharges to state waters. It also empowers Ecology to issue state waste discharge permits and NPDES permits.

8.5.3 Water Resource Laws

Water Resources Act (RCW 90.54)

Provides for the management and protection of state waters. Discharges from treatment systems as well releases from the landfill affect state waters, therefore, this law is directly applicable.

Water Well Construction Act (RCW 18.104)

Provides for the regulation of water well construction. This law will be directly applicable to monitoring and extraction wells on and .

Water Code (RCW 90.03)

Establishes water right permits necessary for water withdrawals, including groundwater extraction.

Water Rights--Registration--Waiver and Relinquishment, etc. (RCW 90.14)

Establishes water right permits necessary for water withdrawals, including groundwater extraction.

8.5.4 Air Quality Laws

Washington Clean Air Act (RCW 70.94)

Applicable for discharging pollutants into the atmosphere from a new source.

<u>Miscellaneous Laws</u>

Construction Projects in State Waters (RCW 75.20)

Requires all proposed construction in stream and river channels to be reviewed by the Washington Department of Fisheries and a "Hydraulic Permit" secured for the work. Any outfall construction of other work within a defined distance of any state waters will make this law and its requirements applicable.

State Environmental Policy Act (WAC 197-11)

Under some circumstances, SEPA compliance may be required. For example, compliance would be required if a state or local agency is asked to issue a permit or license for any phase of remedial work at a Superfund site. Compliance would be required for work. In addition, SEPA requires an evaluation of an agency-proposed project to determine whether it may cause significant adverse environmental impacts. If so, an Environmental Impact Statement (EIS) would be required. So SEPA is certainly relevant and possibly applicable.

Hazardous Waste Regulations

Dangerous Waste Regulations (WAC 173-303)

The following sections of the Dangerous Waste Regulations deal with substantive requirements, as defined in the CERCLA Compliance with Other Laws Manual, page 1-11.

WAC-173-303-010	Purpose
WAC-173-303-016	Identifying solid waste
WAC-173-303-017	Recycling processes involving solid waste
WAC-173-303-020	Applicability
WAC-173-303-030	Abbreviations
WAC-173-303-040	Definitions
WAC-173-303-045	References to EPA's hazardous waste and permit regulations
WAC-173-303-050	Department of Ecology cleanup authority
WAC-173-303-070	Designation of dangerous waste
WAC-173-303-071	Excluded categories of waste
WAC-173-303-080	Dangerous waste lists
WAC-173-303-081	Discarded chemical products
WAC-173-303-082	Dangerous waste sources
WAC-173-303-084	Dangerous waste mixtures
WAC-173-303-090	Dangerous waste
WAC-173-303-100	Dangerous waste criteria
WAC-173-303-101	Toxic dangerous wastes
WAC-173-303-102	Persistent dangerous wastes
WAC-173-303-103	Carcinogenic dangerous wastes
WAC-173-303-104	Generic dangerous wastes
WAC-173-303-110	Sampling and testing methods
WAC-173-303-120	Recycled, reclaimed, and recovered wastes
WAC-173-303-140	Land disposal restrictions
WAC-173-303-141	Treatment, storage, or disposal of dangerous waste
WAC-173-303-145	Spills and discharges into the environment
WAC-173-303-150	Division, dilution, and accumulation

WAC-173-303-160	Containers
WAC-173-303-161	Overpacked containers
WAC-173-303-201	Special accumulation standards
WAC-173-303-202	Special requirements for generators of between two hundred and twenty two thousand two hundred pounds per month that accumulate dangerous waste in tanks
WAC-173-303-230	Special conditions
WAC-173-303-270	Discharges during transport
WAC-173-303-280	General requirements for dangerous waste management facilities
WAC-173-303-283	Performance standards
WAC-173-303-310	Security
WAC-173-303-330	Personnel training
WAC-173-303-340	Preparedness and prevention
WAC-173-303-350	Contingency plan and emergency procedures
WAC-173-303-360	Emergencies
WAC-173-303-395	Other general requirements
WAC-173-303-400	Interim status facility standards
WAC-173-303-420	Siting standards
WAC-173-303-550	Special requirements for facilities managing special waste
WAC-173-303-560	Minimum standards for facilities managing special
WAC-173-303-600	Final facility standards
WAC-173-303-610	Closure and postclosure
WAC-173-303-645	Groundwater protection
WAC-173-303-9903	Discharged chemicals products list
WAC-173-303-9904	Dangerous waste sources list
WAC-173-303-9905	Dangerous waste constituents list
WAC-173-303-9906	Toxic dangerous waste mixtures graph
WAC-173-303-9907	Persistent dangerous waste
WAC-173-303-640	Tank systems
WAC-173-303-650	Surface impoundments
WAC-173-303-660	Waste piles
WAC-173-303-665	Landfills

Applicable for handling groundwater or treatment products which might be classified a dangerous waste.

Water Quality Regulation

Water Quality Standards for the State of Washington, (WAC 173-201)

The following section of the Water Quality standard deal with substantive requirements:

WAC-173-201-035	General Considerations
WAC-173-201-045	General Water use and Criteria Classes
WAC-173-201-047	Toxic Substances
WAC-173-201-080	Specific Classification Freshwater Criteria
WAC-173-201-090	Achievement Considerations
WAC-173-201-100	Implementation
WAC-173-201-110	Surveillance

State Waste Discharge Permit Program (WAC 173-216)

The following sections of the State Waste Discharge Permit Program give the substantive requirements:

WAC-173-216-010	Purpose
WAC-173-216-020	Policy enunciated
WAC-173-216-040	Authorization required
WAC-173-216-060	Prohibited discharges
WAC-173-216-150	Delegation of authority to issue permits for discharges into sewer systems

All discharges to municipal sanitary sewers must be approved by the Department of Ecology. Therefore, this law is applicable to any filter backwash or effluent discharged to the sanitary sewer.

National Pollutant Discharge Elimination System Permit Program (WAC 173-220)

The following are the substantive requirements of the National Pollutant Discharge Elimination System Program:

WAC-173-220-120	Prohibited discharges
WAC-173-220-130	Effluent limitations, water quality standards, and other requirements for permits
WAC-173-220-150	Other terms and conditions
WAC-173-220-210	Monitoring, recording, and reporting
WAC-173-240-120	Review standards
WAC-173-24-140	Plans and specifications
WAC-173-240-150	Operation and maintenance manual
WAC-173-240-160	Requirement for professional engineer
WAC-173-240-170	Right of inspection
WAC-173-240-180	Approval of construction changes

This regulation sets a minimum standard for technical review by the Department of Ecology. It also sets minimum submittal criteria and minimum professional stature requirements for design engineers. This law is directly applicable.

Solid Waste Regulations

Minimum Functional Standards for Solid Waste Handling (WAC 173-304)

The following are the substantive requirements of the Minimum functional standards for solid waste handling:

WAC-173-304-015	Applicability
WAC-173-304-100	Definitions
WAC-173-304-130	Locational standards for disposal sites
WAC-173-240-300	Waste recycling facility standards
WAC-173-304-400	Solid waste handling facility standards
WAC-173-304-405	General facility requirements

WAC-173-304-430	Surface impoundment standards
WAC-173-304-450	Landspreading disposal standards
WAC-173-304-460	Landfilling standards
WAC-173-304-461	Inert waste and demolition waste landfilling facility requirements
WAC-173-304-462	Woodwaste landfilling facility requirements
WAC-173-304-490	Groundwater monitoring requirements
WAC-173-304-600	Permit requirements for solid waste facilities
WAC-173-304-700	Variances

Drinking Water Regulations

Public Water Supplies (WAC 248-54)

Regulations that govern public water supply systems and set maximum contaminant levels for various parameters. Also sets minimum water quality monitoring requirements.

Water Resource Regulations

Minimum Standards for Construction and Maintenance of Wells (WAC 173-160)

The following sections of the Minimum standards for construction and maintenance of wells deal with substantive requirements:

WAC-173-160-010	Purpose
WAC-173-160-050	Records
WAC-173-160-055	Well Construction Notification
WAC-173-160-065	Design and construction
WAC-173-160-075	Design and construction Sealing of casing-general
WAC-173-160-085	Capping
WAC-173-160-105	Comparable construction standards
WAC-173-160-500	Design and construction general (monitoring wells)
WAC-173-160-510	Design and construction Surface protective measures
WAC-173-160-520	Design and construction,Casing

WAC-173-160-530	Design and construction, cleaning
WAC-173-160-540	Design and construction, Well screen, filter pack, and development
WAC-173-160-550	Design and construction, Well seals
WAC-173-160-560	Abandonment of resource protection wells

Requires monitoring wells and extraction wells to have a certain configuration for resource protection. Applicable to all wells drilled as part of the study or remediation.

Regulation and Licensing of Well Contractors and Operators (WAC 173-162)

Requires that all well contractors be licensed by the State of Washington. Applicable to all contractors drilling wells or modifying them in any way.

Protection of Withdrawal Facilities Associated with Groundwater Rights (WAC 173-150)

Applicable to activities that would degrade water quality.

Protection of Upper Aquifer Zones (WAC 173-154)

Restricts activities that would impair senior groundwater rights, including water level lowering and water quality degradation. Applicable to groundwater extractions for aquifer remediation.

<u>Air Regulations</u>

General Regulations for Air Pollution Sources (WAC 173-400)

Applicable to air stripper discharges and gas emissions

Implementation of Regulations for Air Contaminant Sources (WAC 173-403)

Applicable to air stripper discharges and gas emissions

Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC), (WAC 173-490)

Applicable to air stripper discharges and gas emissions

Miscellaneous Regulations

Transportation of Hazardous Materials (WAC 446.50)

Applicable if any hazardous materials from the S.T. Swamp meed to be transported for disposal.

Factors To Be Considered

- Washington Department of Ecology Final Cleanup Policy, 1984

- Water Quality Standards for Groundwaters of the State of Washington, (WAC 173-000???). Draft regulations promulgating standards for state groundwaters. To be promulgated December, 1989.

9.0 PRELIMINARY IDENTIFICATION OF REMEDIAL ALTERNATIVES

9.1 INTRODUCTION

This section identifies remedial technologies that are applicable to the constituents found at South Tacoma Field. Inorganic and organic constituents have been identified at various times and sundry locations on this site. A discussion of constituents that have been found at the STF site is provided in Section 6.0. Examples of inorganic chemicals reported at the site include boron, manganese, lead, chromium, copper, zinc, and iron.

Several classes of organic chemicals are found on-site. Volatiles, acid extractables, base/neutral extractables and PCBs have been found in soil and groundwater samples. Specifically, the volatile organic compounds found include trichlorofluoromethane, trichloroethylene (TCE), and methylene chloride. Examples of acid extractable organic compounds that have been identified are phenol, benzoic acid and acetone. Base/neutral acid extractables such as phthalate and polynuclear aromatic hydrocarbons (PAHs) were reported in soil samples while naphthalene has been reported in soil and groundwater samples.

The constituents mentioned above, and in Section 6.0, have been identified in soils and debris and/or surface waters and groundwaters. Therefore, in considering response action technologies that may be applicable to the STF site, one must not only consider the various types of constituents present, but also the media in which the specified constituent resides.

Various options are available for assessing the effectiveness of candidate response action technologies applicable to the STF site. It is not the purpose of this section to elaborate on criteria that could be used to evaluate the effectiveness of the technologies that are applied to the site. The objective of this section, rather, is to make a preliminary identification of technologies that may be applicable. However, because of the need to establish general criteria to aid in identifying technologies that may be applicable at the site, examples of criteria that could be used to evaluate the effectiveness of a treatment option are listed. These criteria include:

- EP Toxicity Test Procedure,
- Toxicity Characteristic Leaching Procedure (TCLP),
- ASTM Leaching Procedure,

- Accelerated leaching in a column, or batch extractions,
- Suggested soil limits,
- Background soil concentrations,
- Paint Filter Liquids Test (EPA Method 9095, 9/88), and
- Drinking Water Standards.

One item to note is that setting a limit on total concentrations in soil would exclude treatment options whose effectiveness at other waste sites has been demonstrated, e.g., stabilization. It might be more appropriate to use soil concentrations to define the extent of the action effort (i.e., to define those soils requiring treatment).

9.2 DISCUSSION OF THE NO-ACTION ALTERNATIVE

From the assessment of the types of contamination present at the STF site, it is concluded that organics and inorganics are present at concentrations that could potentially pose a threat to human health or the environment. Organic and inorganic levels in the soil are of concern because of their potential for migration to groundwaters underlying the site. An aquifer underlying the site is used for human consumption. Therefore, based on the types and concentrations of contaminants that have heretofore been identified at the site, at this time it cannot be stated that the no-action alternative is a viable alternative.

Precipitation exceeds potential evapotranspiration at the STF site by approximately 16 inches per year. These figures are based on an average annual precipitation of 41 inches (U.S.D.A., 1979) and a potential evapotranspiration for the area of 25 inches (Geraghty and Miller, 1973). Therefore; annual precipitation is adequate to cause the migration of contaminants from the soils to groundwater which has been stated to lie 10 to 40 feet below the surface. Severe storm events could also potentially generate sufficient excess moisture to move contaminants downwards. Based on data from the U.S. Department of Commerce, a 100 year storm event in the Tacoma area will provide 6 inches of rainfall during a 24-hour period. Irrespective of any storm events, which by themselves have the potential to move contaminants to the groundwater, consideration of precipitation and evapotranspiration values for the Tacoma area indicates that the potential exists for the movement of contaminants through the soil profile with the recharge that is occurring.

Due to these considerations, the no-action alternative is not presently an acceptable alternative for soils and surface and groundwaters at the STF site. There is a possibility of generating recharge waters that would carry contamination found in soils to the aquifer used for human consumption.
The no-action alternative would, additionally, allow for the continued possibility of dust releases during wind storms and possible direct contact with soils and debris.

9.3 IDENTIFICATION OF APPLICABLE TECHNOLOGIES

9.3.1 Remedial Action Objectives and Goals

Evaluation of the no-action alternative has indicated that adverse impacts are probable and, therefore, until additional data are collected, and protective criteria established through a risk assessment, it cannot be stated with certainty that the no-action alternative will protect human health and the environment to the level ultimately required by EPA.

Evaluation of the many possible response actions requires formulation of remedial action goals and objectives. Potential environmental protection goals discussed in Sections 6.0 and 8.0 are related to protection of the groundwaters, aquifers, and soils. In addition to these primary goals, there are a number of other goals that must be considered. Generally, these secondary goals address the relative desirability of response alternatives. That is, it is assumed that alternatives considered for evaluation will be capable of meeting the environmental protection goal. The purpose of the evaluation criteria is then to assist in determining which of these approaches are most desirable.

After identification of specific goals related to the remedial action, criteria are developed to provide a means of assessing if these goals are being met. This assessment can be made less subjective if the criteria can be expressed in quantitative terms. The goals and criteria developed for the preliminary identification of response actions at the STF site are based on the effectiveness and implementability of the response action (remedial technology) in addressing environmental concerns. The effectiveness and implementability criteria are briefly discussed below.

Technical Effectiveness

Technical effectiveness criteria are based on the ability of an alternative to meet remedial action goals. Only technologies capable of meeting the environmental protection goals developed in Sections 6.0 and 8.0 with an acceptable level of risk are considered. Therefore, consideration of technical effectiveness is determined by the uncertainty involved in meeting this goal, i,e., the reliability of a technology.

A general goal should be to select methods which are effective in meeting the environmental protection goal with a high degree of certainty. The ability of an alternative to meet this goal should be assessed by comparison of required performance with typical or expected performance. Assessment of effectiveness is expressed by the following criterion:

- The required technical performance of a response action should be within the typical range of operating performance for that alternative.

Implementability

Implementability criteria should address site-specific conditions which may impact implementation of the response action. Typically, implementability concerns result from requirements for materials or conditions which may not be present at the site. Remedial alternatives should generally be chosen which do not require materials or conditions not readily available at the site.

This goal is reflected in the following criteria:

- A general goal should be to select methods which are not significantly impacted by site conditions.

Potential technologies were identified through a two-step process: 1) enumeration of technologies available that met the criteria discussed in the preceding paragraphs and 2) elimination of those technologies which are not appropriate for contaminants or contaminated media at this site.

9.3.2 **Candidate Technologies for use at the STF Site**

The applicability of individual remedial technologies is determined by the nature of the contaminant problems at the STF site. As discussed previously, both inorganic and organic contaminants are found at this site. For the purposes of this preliminary identification of remedial alternatives, technologies that address contaminated soils and surface and groundwaters will be identified.

Various technologies and processes that can be applied to contaminated soils are listed below and briefly described. These technologies fall into three broad categories: 1) removal and treatment/disposal; 2) isolation through barriers to migration; and 3) in-situ treatment. Each technology within these categories is listed and briefly described. Candidate technologies are defined as those that are deemed applicable.

Removal and Treatment/Disposal

- Excavation and disposal - Remove wastes to an hazardous waste facility. Applicable to metals and organics in soils.

- Excavation and on-site disposal - Involves relocating contaminated soils until a final treatment or disposal option is implemented, or to landfills. Applicable to metals and organics.

- Stabilization - Reagents that are used to physically and/or chemically stabilize soil contaminants include: Portland cement, cement kiln dust, lime, lime kiln dust, asphalt, polyethylene, polypropylene, wax, elemental sulfur, fly ash, blast furnace slag, soluble silicates. Applicable to metals and organics depending upon which stabilization reagents are used.

- Air Stripping - Involves the passage of water through a stripping tower where the VOC constituents are removed from the groundwater by being transferred from the liquid to the gas phase. Air stripping is generally most applicable for organic compounds with Henry's Law constants grater than 0.003. Applicable to organics.

- Incineration - Contaminants are oxidized in the presence of air to innocuous combustion products such as CO_2, H_2O, HCl, and SO_2. Applicable to organics.

- Liquid/Solids Systems - These systems treat organic tars/sludges and contaminated soils by extracting the organics into an aqueous phase and biologically degrading them. Applicable to organics.

- Granular Activated Carbon (GAC) Adsorption - GAC adsorption provides an effective means for removal of VOC components from extracted groundwater, and is most applicable for organic compounds with molecular weights from 200 to 5,000. Applicable to organics.

- UV-Oxidation - An oxidizing agent, such as hydrogen peroxide or ozone, is used, in combination with ultraviolet light, to degrade organics. Applicable to organics.

- Ultraviolet Photolysis - Photolytic oxidation is a process that destroys chemicals in aqueous solutions utilizing ultraviolet radiation. Applicable to organics.

- Ion Exchange - Ion exchange is a reversible process wherein toxic ions are removed from the aqueous phase by being exchanged with relatively non-toxic ions held by the ion exchange material. Examples of exchanger materials are synthetic resins, natural clays, or zeolites. Applicable to inorganics and some organics.

The following removal and treatment remedial technologies were considered but were not deemed applicable to the STF site when evaluated with the criteria described previously.

- Steam Stripping - Steam stripping involves the removal of VOCs from water by direct heating with steam injection into the water to transfer the VOCs from the liquid phase into the gas phase. Steam stripping is most commonly used for removing organic compounds from water with concentration ranges greater than 1.0 to 3.0 percent by weight. Concentrations at the STF site are below its range of applicability, and steam stripping offers no advantages over the less expensive air stripping process.

- Fractional Distillation - Fractional distillation for the removal of VOCs in water makes use of the difference in boiling points between the organic constituents and water. Distillation is most commonly used to remove organic constituents that are present in water in concentration above 5.0 to 8.0 percent by weight and is not normally used except when recovery of the VOCs is desired. Distillation equipment is complex and expensive, and has high operating costs. Therefore, fractional distillation is not considered applicable to the STF site.

- Liquid Evaporation - Liquid evaporation involves heating water sufficiently to selectively evaporate the VOC constituents from the aqueous phase into the gaseous phase. The method is very expensive, has a high energy requirement, and results in the generation of a highly concentrated liquid waste stream requiring fractional distillation or disposal.

- Liquid-Liquid Extraction - Liquid-liquid extraction involves the removal of organic constituents from groundwater by contact with an immiscible organic solvent. The costs for liquid-liquid extraction are high because the recovery of VOCs from the solvent has high capital and operating costs. Also, liquid-liquid extraction may not be able to sufficiently reduce chemical concentrations.

- Critical Fluid Extraction - Critical fluid extraction involves the removal of organic constituents from water by contact with carbon dioxide or some other agent in a supercritical state. Critical fluid extraction is a relatively new process with very limited experience.

Isolation - Barriers to Migration

- Horizontal containment with low permeability walls:
    - Soil-Bentonite Slurry Walls - Of the various types of slurry walls, soil-bentonite walls offer the lowest overall cost, the widest range of chemical compatibilities, and the lowest permeabilities if properly constructed. Applicable to metals or organics.

    - Cement-Bentonite Slurry Walls - Generally constructed using a slurry of Portland cement, bentonite, and water. Applicable to metals and organics.

- Diaphragm Slurry Walls - Are composed of reinforced concrete panels. Rarely used because the degree of compressive strength attained is seldom required at a site. Applicable to metals and organics

- Cement-Asphalt Emulsion Slurry Walls - Have been used as a barrier material to deal with organic contaminants which tend to penetrate soil-bentonite and cement-bentonite slurry walls. Applicable to metals and organics.

- Grout Walls or Curtains - They are rarely used for groundwater control in unconsolidated materials. Myriad grouts are available for use including cement, clay, bentonite clay, alkali silicates, silicate, organic polymers, urea-formaldehyde, epoxy, and polyester. Applicable to metals and organics.

- Sheet Piles - Sheet piles can be made of steel, pre-cast concrete, or wood. Steel sheet piles should not be considered for use in corrosive or rocky environments. Applicable to metals and organics.

- Flexible Membrane Liners - Flexible membrane liners may be valuable in constructing barrier walls in cases where hydrocarbons could degrade earthen liners. Applicable to metals and organics.

- Surface Covers - Surface covers are used to reduce the percolation of water into the waste area. Normally synthetic membranes and/or clay are used. Applicable to metals and organics.

- Bottom Sealing through Grouting - Construction of a bottom seal through grouting would entail the drilling of holes through the waste and injecting the grout to form a barrier. Applicable to metals and organics.

- Bottom Sealing through Block Displacement - Block displacement involves the construction of a perimeter barrier and the injection of grout through holes drilled into the waste. The grout is injected until the waste volume, defined by the perimeter barrier, is displaced. Applicable to metals and organics.

In-Situ Treatment

- In-Situ Bioreclamation - Naturally occurring bacteria can degrade phenolics and petroleum hydrocarbons. Applicable to organics.

- In-Situ Chemical Precipitation/Complexation - Chemical precipitation and complexation reactions have been used to remove inorganics from waste streams. Precipitation reactions could also be used to immobilize metals in soils. Applicable to metals.

- Land Treatment - This is a proven technology for degrading organics. Applicable to organics.

- Soil Washing - Chemical reagents are used to remove organics or inorganics from soil. Could be performed in-situ or on excavated soils. Applicable to metals and organics.

- Composting - Composting uses biological processes to degrade organic chemicals. Applicable to organics.

- Vitrification - Vitrification transforms soils into a glassy matrix through resistance heating of the soil to the melting point. Applicable to metals and organics.

- Soil Heating - Soil is heated to a high enough temperature to drive off specified organics. Collection device is installed at the surface to collect organic vapors.

- Vapor Extraction - Used to remove volatile organic compounds from soils. May be accomplished by the application of a vacuum or by steam. Applicable to organics.

- Ground freezing - Install cryogenic machinery to freeze the soils at a given location to reduce the permeability and transportation of inorganics and organics.

Candidate technologies for metal and organic-contaminated soils and waters identified in the preceding section are summarized in Tables 9-1a through 9-1c.

A preliminary list of data needs and objectives for the candidate remedial technologies that were identified is provided in Table 9-2.

TABLE 9-1a

SUMMARY TABLE OF CANDIDATE REMEDIAL TECHNOLOGIES

Removal and Treatment/Disposal

Remedial Technologies	Media	Constituents
Excavation and disposal	Soils	Metals, Organics
Excavation and on-site disposal	Soils	Metals, Organics
Stabilization	Soils	Metals, Organics
Air Stripping	Aqueous	Organics
Incineration	Soils, Aqueous	Organics
Liquid/Solids	Soils	Organics
Granular Activated Carbon (GAC)	Aqueous	Organics
UV-Oxidation	Aqueous	Organics
Ultraviolet	Aqueous	Organics
Ion Exchange	Aqueous	Metals, Organics

TABLE 9-1b

SUMMARY TABLE OF CANDIDATE REMEDIAL TECHNOLOGIES

Isolation

Remedial Technology	Media	Constituents
Containment with low permeability walls	Aqueous	Metals, Organics
Surface covers	Soils	Metals, Organics
Bottom sealing through grouting	Soils	Metals, Organics
Bottom sealing through block displacement	Soils	Metals, Organics

TABLE 9-1c

SUMMARY TABLE OF CANDIDATE REMEDIAL TECHNOLOGIES

In-Situ Treatment

Remedial Technologies	Media	Constituents
In-Situ Bioreclamation	Soils/aqueous	Organics
In-Situ Chemical Precipitation	Aqueous/Soils	Metals
Land Treatment	Soils/Aqueous	Organics
Soil Washing	Soils	Metals/Organics
Composting	Soils	Organics
Vitrification	Soils	Metals, Organics
Soil Heating	Soils	Organics
Vapor Extraction	Soils	Organics
Ground Freezing	Aqueous/Soils	Metals/Organics

TABLE 9-2

LIST OF PRELIMINARY DATA NEEDS FOR THE CANDIDATE REMEDIAL TECHNOLOGIES

Extent of contamination	Depth to impermeable strata	Priority pollutant analysis
Depth to groundwater table	Seismic history	TDS concentration
Availability of cover materials	Heterogeneity of subsurface formation	TSS concentration
Soil characteristics	Groundwater depth, rate and direction of flow	
- Gradation - Atterberg limits - %-Moisture - Compaction - Permeability - Strength - Clay types	Soil Chemistry	
Climate (precipitation)	Chemistry of waste and groundwater	
Land use	Groundwater pH, sulfides, calcium	
Contaminant characteristics	Depth to bedrock (impermeable strata)	
Topography	Aquifer transmissivity	
Accessibility of site materials	Aquifer storativity	
Gross organic components (TOC)		
Specific organic constituents		

APPENDIX A

SUMMARY OF SITE DATA

TABLE A1. SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: TACOMA-PIERCE CO. HEALTH DEPT., 82 **

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
1982	FOUNDRY PRKNG LOT	TOTAL	COMPOSITE	SURFACE		130			19		36,500	
1982	FOUNDRY PRKNG LOT	TOTAL	LUMP	SURFACE								

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
1982	FOUNDRY PRKNG LOT	TOTAL	COMPOSITE	SURFACE		190	136,700	2100			31,500
1982	FOUNDRY PRKNG LOT	TOTAL	LUMP	SURFACE			2700				

** ORIGINAL REFERENCE NOT AVAILABLE - TAKEN FROM SAIC SUMMARY, 89, P. 10

WHERE REPORTED: PIERCE CO. HEALTH DEPT., 86

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
2/86	SB4	TOTAL	GRAB	2 FT		13		81	13	23		
2/86	SB5	TOTAL	GRAB	0.5 FT		12		110	2	162		

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
2/86	SB4	TOTAL	GRAB	2 FT			465				
2/86	SB5	TOTAL	GRAB	0.5 FT			964				

TA[redacted] (CC[redacted] SOI[redacted]

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu
10/11/82	CBS-09	TOTAL	GRAB	28 FT	620	ND		ND	ND	ND	ND
10/11/82	CBS-09	TOTAL	GRAB	33 FT	490	ND		ND	ND	ND	ND
10/11/82	CBS-10	TOTAL	GRAB	23 FT	850	ND		ND	ND	ND	ND
10/11/82	CBS-10	TOTAL	GRAB	38 FT	590	1.2		ND	ND	ND	ND
10/14/82	CBS-11	TOTAL	GRAB	18 FT	550	1.8		ND	ND	ND	ND
10/14/82	CBS-11	TOTAL	GRAB	38 FT	580	1.3		ND	ND	ND	ND
10/13/82	CBS-12	TOTAL	GRAB	13 FT	610	1.3		ND	ND	ND	ND
10/13/82	CBS-12	TOTAL	GRAB	28 FT	620	1.1		ND	ND	ND	ND
11/16/82	CBS-13	TOTAL	GRAB	48 FT	1168	1.1		11	0.2	1.4	5.4
11/16/82	CBS-13	TOTAL	GRAB	78 FT	1321	1.1		11	0.6	2.3	ND

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
10/11/82	CBS-09	TOTAL	GRAB	28 FT	21	5.6	1.4				
10/11/82	CBS-09	TOTAL	GRAB	33 FT	17	4.2	6.1				
10/11/82	CBS-10	TOTAL	GRAB	23 FT	63	ND	2				
10/11/82	CBS-10	TOTAL	GRAB	38 FT	33	ND	2.1				
10/14/82	CBS-11	TOTAL	GRAB	18 FT	36	ND	2.8				
10/14/82	CBS-11	TOTAL	GRAB	38 FT	23	ND	2.2				
10/13/82	CBS-12	TOTAL	GRAB	13 FT	20	ND	3.9				
10/13/82	CBS-12	TOTAL	GRAB	28 FT	36	ND	1.3				
11/16/82	CBS-13	TOTAL	GRAB	48 FT	28	ND	0.9				
11/16/82	CBS-13	TOTAL	GRAB	78 FT	38	9.3	0.7				

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
10/18/82	CBS-26	TOTAL	GRAB	SURFACE	1100	4.6	ND	34	0.2	2.8	31	470
10/18/82	CBS-27	TOTAL	GRAB	1 FOOT	1900	2.2	ND	22	0.2	ND	ND	680
10/18/82	CBS-28	TOTAL	GRAB	SURFACE	1000	1.3	ND	ND	0.3	ND	ND	250
10/18/82	CBS-29	TOTAL	GRAB	1 FOOT	3500	5.4	ND	18	0.2	ND	6.9	440
10/18/82	CBS-30	TOTAL	GRAB	SURFACE	2200	4.3	ND	ND	0.4	ND	6.8	310
10/18/82	CBS-31	TOTAL	GRAB	1 FOOT	2300	1.4	ND	23	0.5	ND	ND	260
10/18/82	CBS-32	TOTAL	GRAB	SURFACE	540	ND	ND	17	ND	ND	ND	690
10/18/82	CBS-33	TOTAL	GRAB	1 FOOT	360	ND	ND	ND	0.7	ND	ND	410
10/18/82	CBS-34	TOTAL	GRAB	SURFACE	1200	110	ND	46	0.2	ND	330	1040
10/18/82	CBS-35	TOTAL	GRAB	1 FOOT	3400	6	ND	18	0.4	ND	52	2800
10/18/82	CBS-36	TOTAL	GRAB	SURFACE	1200	2	22	62	ND	54	21	3000
10/18/82	CBS-37	TOTAL	GRAB	1 FOOT	510	ND	ND	48	3.4	2.8	ND	920
10/18/82	CBS-38	TOTAL	GRAB	SURFACE	1000	2.9		71	0.4	24	28	4900
10/18/82	CBS-39	TOTAL	GRAB	1 FOOT	3900	8		ND	0.5	ND	ND	230
10/18/82	CBS-40	TOTAL	GRAB	SURFACE	1600	2.3		56	0.2	ND	20	5800
10/18/82	CBS-41	TOTAL	GRAB	1 FOOT	1600	6.7		56	1.7	ND	2800	2500
10/18/82	CBS-47	TOTAL	GRAB	SURFACE	670	ND		140	0.4	20	51	6200
10/18/82	CBS-48	TOTAL	GRAB	1 FOOT	1700	1.6		68	ND	11	29	3600
10/11/82	CBS-01	TOTAL	GRAB	23 FT *	940	ND		ND	ND	ND	ND	790
10/11/82	CBS-01	TOTAL	GRAB	28 FT	950	ND		ND	ND	1.8	ND	860
10/13/82	CBS-02	TOTAL	GRAB	13 FT	1000	ND		ND	ND	ND	ND	1370
10/13/82	CBS-02	TOTAL	GRAB	28 FT	580	ND		ND	ND	ND	ND	480
10/09/82	CBS-03	TOTAL	GRAB	28 FT	990	ND		ND	ND	1.2	7.2	990
10/09/82	CBS-03	TOTAL	GRAB	38 FT	80	ND		ND	ND	ND	ND	760
10/11/82	CBS-04	TOTAL	GRAB	18 FT	780	ND		ND	0.2	1.3	ND	460
10/11/82	CBS-04	TOTAL	GRAB	38 FT	820	ND		ND	0.2	2.2	ND	830
10/11/82	CBS-05	TOTAL	GRAB	13 FT	1100	1.4		ND	ND	2.2	ND	1350
10/11/82	CBS-05	TOTAL	GRAB	23 FT	720	ND		ND	ND	1.5	ND	790
10/12/82	CBS-06	TOTAL	GRAB	13 FT	1400	2.2		ND	ND	1.2	ND	930
10/12/82	CBS-06	TOTAL	GRAB	23 FT	480	ND		ND	ND	ND	ND	840
10/12/82	CBS-07	TOTAL	GRAB	18 FT	830	ND		ND	ND	ND	ND	730
10/12/82	CBS-07	TOTAL	GRAB	47 FT	570	ND		ND	ND	ND	ND	620
10/13/82	CBS-08	TOTAL	GRAB	13 FT	1300	6		45	0.2	4.4	ND	2900
10/13/82	CBS-08	TOTAL	GRAB	18 FT	520	1.5		ND	ND	ND	ND	1300

* SAMPLE DEPTH TAKEN FROM SAIC 89 SUMMARY

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
10/18/82	CBS-26	TOTAL	GRAB	SURFACE	35	ND	72	ND	ND		91
10/18/82	CBS-27	TOTAL	GRAB	1 FOOT	60	ND	6.5	ND	ND		10
10/18/82	CBS-28	TOTAL	GRAB	SURFACE	41	ND	8.8	ND	ND		19
10/18/82	CBS-29	TOTAL	GRAB	1 FOOT	83	ND	14	ND	ND		47
10/18/82	CBS-30	TOTAL	GRAB	SURFACE	10	ND	86	ND	ND		6.8
10/18/82	CBS-31	TOTAL	GRAB	1 FOOT	32	ND	12	ND	ND		2.1
10/18/82	CBS-32	TOTAL	GRAB	SURFACE	25	ND	2.8	ND	ND		5.8
10/18/82	CBS-33	TOTAL	GRAB	1 FOOT	21	ND	1.4	ND	ND		2.7
10/18/82	CBS-34	TOTAL	GRAB	SURFACE	430	35	200	13	ND		120
10/18/82	CBS-35	TOTAL	GRAB	1 FOOT	1800	5.7	31	3.6	ND		15
10/18/82	CBS-36	TOTAL	GRAB	SURFACE	230	15	35	ND	ND		21
10/18/82	CBS-37	TOTAL	GRAB	1 FOOT	46	ND	17	ND	ND		3.8
10/18/82	CBS-38	TOTAL	GRAB	SURFACE	230	20	65	ND			41
10/18/82	CBS-39	TOTAL	GRAB	1 FOOT	7.5	ND	4.1	ND			7.5
10/18/82	CBS-40	TOTAL	GRAB	SURFACE	720	ND	54	ND			11
10/18/82	CBS-41	TOTAL	GRAB	1 FOOT	410	ND	4300	47			1800
10/18/82	CBS-47	TOTAL	GRAB	SURFACE	1030	69	23	ND			19
10/18/82	CBS-48	TOTAL	GRAB	1 FOOT	210	46	16	ND			9.1
10/11/82	CBS-01	TOTAL	GRAB	23 FT	59	ND	1.5			ND	4.2
10/11/82	CBS-01	TOTAL	GRAB	28 FT	64	ND	1.2			ND	4.9
10/13/82	CBS-02	TOTAL	GRAB	13 FT	30	ND	1.5			ND	5.7
10/13/82	CBS-02	TOTAL	GRAB	28 FT	18	ND	0.6			ND	2.9
10/09/82	CBS-03	TOTAL	GRAB	28 FT	89	ND	2.3			ND	6.2
10/09/82	CBS-03	TOTAL	GRAB	38 FT	46	ND	3.6			ND	5.1
10/11/82	CBS-04	TOTAL	GRAB	18 FT	33	ND	1			ND	1.9
10/11/82	CBS-04	TOTAL	GRAB	38 FT	41	4.6	1.3			ND	5
10/11/82	CBS-05	TOTAL	GRAB	13 FT	191	ND	2.3			ND	6.2
10/11/82	CBS-05	TOTAL	GRAB	23 FT	108	ND	1.1			ND	5.1
10/12/82	CBS-06	TOTAL	GRAB	13 FT	23	5.1	5			ND	6.1
10/12/82	CBS-06	TOTAL	GRAB	23 FT	13	4.1	1			ND	4.2
10/12/82	CBS-07	TOTAL	GRAB	18 FT	78	4.9	1.3			ND	4.8
10/12/82	CBS-07	TOTAL	GRAB	47 FT	31	ND	0.8			ND	3.9
10/13/82	CBS-08	TOTAL	GRAB	13 FT	42	6.4	15.9			ND	4
10/13/82	CBS-08	TOTAL	GRAB	18 FT	25	6.3	7.3			ND	12

TA[redacted] (C[redacted] SOI[redacted]

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: GEO ENGINEERS, INC, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH			pH
1985	7-A	TOTAL	GRAB	5 FT	LIME DEBRIS		12.3
1985	13-A	TOTAL	GRAB	1 FT	LIME DEBRIS		12.3
1985	13-B	TOTAL	GRAB	3 FT	SOIL	LOW METAL	MODERATE
1985	13-C	TOTAL	GRAB	8 FT	SOIL	LOW METAL	MODERATE

[redacted] TA[redacted] (C[redacted] SOI[redacted]

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: EARTH CONSULTANTS AND BENLAB, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
2/85	TP-1	TOTAL	GRAB	2 FT		0.18						
2/85	TP-3	TOTAL	GRAB	1 FT		0.03						
2/85	TP-4	TOTAL	GRAB	0-0.5 FT		0.12						
2/85	TP-4	TOTAL	GRAB	2.5 FT		0.05						
2/85	TP-4	TOTAL	GRAB	6.5 FT		0.14						
2/85	TP-4	TOTAL	GRAB	14 FT		0.16						
2/85	TP-5	TOTAL	GRAB	1-2 FT		ND						
2/85	TP-6	TOTAL	GRAB	SURFACE		0.05						
2/85	TP-6	TOTAL	GRAB	6 FT		0.16						
2/85	TP-6	TOTAL	GRAB	15 FT		0.03						
2/85	TP-7	TOTAL	GRAB	1.5 FT		0.12						
2/85	TP-7	TOTAL	GRAB	17 FT		0.08						
2/85	TP-8	TOTAL	GRAB	2 FT		0.16						
2/85	TP-8	TOTAL	GRAB	7 FT		0.16						
2/85	TP-8	TOTAL	GRAB	17 FT		0.14						
2/85	TP-9	TOTAL	GRAB	9 FT		0.17						
2/85	TP-9	TOTAL	GRAB	15 FT		0.16						
2/85	TP-10	TOTAL	GRAB	1 FT		.20						
2/85	TP-10	TOTAL	GRAB	6 FT		0.17						
2/85	TP-10	TOTAL	GRAB	16 FT		0.11						
2/85	TP-11	TOTAL	GRAB	2-3 FT		0.15						
2/85	TP-11	TOTAL	GRAB	10-12 FT		0.14						
2/85	TP-11	TOTAL	GRAB	16-17 FT		0.11						
2/85	TP-13	TOTAL	GRAB	3-5 FT		.2						
2/85	TP-13	TOTAL	GRAB	7-11 FT		0.16						

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: EARTH CONSULTANTS AND BENLAB, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
2/85	TP-1	TOTAL	GRAB	2 FT			1250				
2/85	TP-3	TOTAL	GRAB	1 FT			138				
2/85	TP-4	TOTAL	GRAB	0-0.5 FT			5696				
2/85	TP-4	TOTAL	GRAB	2.5 FT			3530				
2/85	TP-4	TOTAL	GRAB	6.5 FT			581				
2/85	TP-4	TOTAL	GRAB	14 FT			39				
2/85	TP-5	TOTAL	GRAB	1-2 FT			1640				
2/85	TP-6	TOTAL	GRAB	SURFACE			87,200				
2/85	TP-6	TOTAL	GRAB	6 FT			621				
2/85	TP-6	TOTAL	GRAB	15 FT			60				
2/85	TP-7	TOTAL	GRAB	1.5 FT			752				
2/85	TP-7	TOTAL	GRAB	17 FT			26				
2/85	TP-8	TOTAL	GRAB	2 FT			2900				
2/85	TP-8	TOTAL	GRAB	7 FT			313				
2/85	TP-8	TOTAL	GRAB	17 FT			30				
2/85	TP-9	TOTAL	GRAB	9 FT			1180				
2/85	TP-9	TOTAL	GRAB	15 FT			43				
2/85	TP-10	TOTAL	GRAB	1 FT			455				
2/85	TP-10	TOTAL	GRAB	6 FT			267				
2/85	TP-10	TOTAL	GRAB	16 FT			69				
2/85	TP-11	TOTAL	GRAB	2-3 FT			457				
2/85	TP-11	TOTAL	GRAB	10-12 FT			694				
2/85	TP-11	TOTAL	GRAB	16-17 FT			27				
2/85	TP-13	TOTAL	GRAB	3-5 FT			1130				
2/85	TP-13	TOTAL	GRAB	7-11 FT			129				

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: EARTH CONSULTANTS AND BENLAB, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
2/85	TP-14	TOTAL	GRAB	2-5 FT		ND						
2/85	TP-25	TOTAL	GRAB	4.5-6 FT		0.04						
2/85	NO ID	TOTAL	GRAB	SURFACE		ND						
2/85	TP-4	EP TOX	GRAB	0-0.5 FT								
2/85	TP-4	EP TOX	GRAB	2.5 FT					0.01	0.25		
2/85	TP-4	EP TOX	GRAB	6.5 FT								
2/85	TP-4	EP TOX	GRAB	11-13 FT								
2/85	TP-4	EP TOX	GRAB	14 FT						0.02		
2/85	TP-5	EP TOX	GRAB	1-2 FT								
2/85	TP-5	EP TOX	GRAB	12-13 FT								
2/85	TP-6	EP TOX	GRAB	0-0.5 FT					0.01	0.03		
2/85	TP-6	EP TOX	GRAB	3 FT								
2/85	TP-6	EP TOX	GRAB	6 FT								
2/85	TP-6	EP TOX	GRAB	10.5 FT								
2/85	TP-6	EP TOX	GRAB	15 FT						0.01		
2/85	TP-10	EP TOX	GRAB	1 FT								
2/85	TP-13	EP TOX	GRAB	7-11 FT								
2/85	TP-13	EP TOX	GRAB	15-16 FT								
2/85	TP-14	EP TOX	GRAB	5-7 FT								
2/85	TP-16	EP TOX	GRAB	1-5 FT								
2/85	TP-19	EP TOX	GRAB	0-1.5 FT								
2/85	TP-26	EP TOX	GRAB	3-5 FT								
2/85	TP-28	EP TOX	GRAB	0-0.5 FT								
2/85	TP-30	EP TOX	GRAB	0-1 FT								
2/85	G-18	EP TOX	GRAB	--								

** 53 ADDITIONAL SAMPLES NOT LISTED - ARSENIC AND LEAD WERE BELOW DETECTION LIMITS - NO INFORMATION AVAILABLE ON THE OTHER CONSTITUENTS

WHERE REPORTED: KENNEDY/JENKS/CHILTON, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
9/86	MW-1A	TOTAL	GRAB	SURFACE								
9/86	MW-2A	TOTAL	GRAB	SURFACE								
9/86	MW-2B	TOTAL	GRAB	3.5 FT								
9/86	MW-2C	TOTAL	GRAB	8.5 FT								

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: EARTH CONSULTANTS AND BENLAB, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
2/85	TP-14	TOTAL	GRAB	2-5 FT			125				
2/85	TP-25	TOTAL	GRAB	4.5-6 FT			477				
2/85	NO ID	TOTAL	GRAB	SURFACE			16,500				
2/85	TP-4	EP TOX	GRAB	0-0.5 FT			0.3				
2/85	TP-4	EP TOX	GRAB	2.5 FT			2.8				
2/85	TP-4	EP TOX	GRAB	6.5 FT			0.2				
2/85	TP-4	EP TOX	GRAB	11-13 FT			0.3				
2/85	TP-4	EP TOX	GRAB	14 FT			<0.1				
2/85	TP-5	EP TOX	GRAB	1-2 FT			0.4				
2/85	TP-5	EP TOX	GRAB	12-13 FT			<0.1				
2/85	TP-6	EP TOX	GRAB	0-0.5 FT			580				
2/85	TP-6	EP TOX	GRAB	3 FT			0.6				
2/85	TP-6	EP TOX	GRAB	6 FT			0.1				
2/85	TP-6	EP TOX	GRAB	10.5 FT			0.4				
2/85	TP-6	EP TOX	GRAB	15 FT			0.1				
2/85	TP-10	EP TOX	GRAB	1 FT			0.4				
2/85	TP-13	EP TOX	GRAB	7-11 FT			0.1				
2/85	TP-13	EP TOX	GRAB	15-16 FT			0.4				
2/85	TP-14	EP TOX	GRAB	5-7 FT			0.5				
2/85	TP-16	EP TOX	GRAB	1-5 FT			0.2				
2/85	TP-19	EP TOX	GRAB	0-1.5 FT			0.2				
2/85	TP-26	EP TOX	GRAB	3-5 FT			0.3				
2/85	TP-28	EP TOX	GRAB	0-0.5 FT			0.1				
2/85	TP-30	EP TOX	GRAB	0-1 FT			0.4				
2/85	G-18	EP TOX	GRAB	--			0.4				

** 53 ADDITIONAL SAMPLES NOT LISTED - ARSENIC AND LEAD WERE BELOW DETECTION LIMITS - NO INFORMATION AVAILABLE ON THE OTHER CONSTITUENTS

WHERE REPORTED: KENNEDY/JENKS/CHILTON, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
9/86	MW-1A	TOTAL	GRAB	SURFACE			84				
9/86	MW-2A	TOTAL	GRAB	SURFACE			2800				
9/86	MW-2B	TOTAL	GRAB	3.5 FT			4200				
9/86	MW-2C	TOTAL	GRAB	8.5 FT			54				

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: PIERCE CO HEALTH DEPT., 86

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
2/86	SC1	TOTAL	COMPOSITE									
2/86	SC2	TOTAL	COMPOSITE	SURFACE		11		150	<2	28		
2/86	S-1	TOTAL	GRAB	SURFACE		14		230	<2	72		
2/86	S-2	TOTAL	GRAB	SURFACE		16		320	5	51		
2/86	S-3	TOTAL	GRAB	SURFACE		20		1940	2	642		
2/86	S-4	TOTAL	GRAB	SURFACE		36		430	<2	28		
2/86	S-5	TOTAL	GRAB	SURFACE		25		860	7	45		
2/86	S-6	TOTAL	GRAB	SURFACE		26		290	2	29		
2/86	S-1	EP TOX	GRAB	SURFACE				0.28		0.06		
2/86	S-2	EP TOX	GRAB	SURFACE				2.1		0.08		
2/86	S-3	EP TOX	GRAB	SURFACE				4.1		0.08		
2/86	S-4	EP TOX	GRAB	SURFACE						0.06		
2/86	S-5	EP TOX	GRAB	SURFACE				4.7				
2/86	S-6	EP TOX	GRAB	SURFACE				2.3				
2/86	SB4	EP TOX	GRAB	2 FT				1.1				
2/86	SB5	EP TOX	GRAB	0.5 FT				1.3		0.06		

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
2/86	SC1	TOTAL	COMPOSITE								
2/86	SC2	TOTAL	COMPOSITE	SURFACE			487				
2/86	S-1	TOTAL	GRAB	SURFACE			864				
2/86	S-2	TOTAL	GRAB	SURFACE			7480				
2/86	S-3	TOTAL	GRAB	SURFACE			5750				
2/86	S-4	TOTAL	GRAB	SURFACE			2050				
2/86	S-5	TOTAL	GRAB	SURFACE			146,500				
2/86	S-6	TOTAL	GRAB	SURFACE			1990				
2/86	S-1	EP TOX	GRAB	SURFACE							
2/86	S-2	EP TOX	GRAB	SURFACE			160				
2/86	S-3	EP TOX	GRAB	SURFACE			10.4				
2/86	S-4	EP TOX	GRAB	SURFACE			0.3				
2/86	S-5	EP TOX	GRAB	SURFACE			4850				
2/86	S-6	EP TOX	GRAB	SURFACE			16.1				
2/86	SB4	EP TOX	GRAB	2 FT			0.3				
2/86	SB5	EP TOX	GRAB	0.5 FT			0.6				

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
2/87	27-39/40	TOTAL	COMPOSITE	4-12 IN		13				52	160	
2/87	27-45/46	TOTAL	COMPOSITE	4-12 IN		9.6				28	260	
2/87	27-47/48	TOTAL	COMPOSITE	4-12 IN		16				32	280	
2/87	27-49/50	TOTAL	COMPOSITE	4-12 IN		13				26	120	
2/87	27-59/60	TOTAL	COMPOSITE	4-12 IN		38				35	420	
2/87	27-59/60	TOTAL	COMPOSITE	4-12 IN		36				43	300	
2/87	27-65/66	TOTAL	COMPOSITE	4-12 IN		14				24	120	
2/87	27-69/70	TOTAL	COMPOSITE	4-12 IN		14				26	260	
2/87	27-71/72	TOTAL	COMPOSITE	4-12 IN		33				36	280	
2/87	27-73/74	TOTAL	COMPOSITE	4-12 IN		11				82	39000	
2/87	27-75/8	TOTAL	COMPOSITE	4-12 IN		21				19	180	

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
2/87	27-39/40	TOTAL	COMPOSITE	4-12 IN		36	200				270
2/87	27-45/46	TOTAL	COMPOSITE	4-12 IN			2300				130
2/87	27-47/48	TOTAL	COMPOSITE	4-12 IN			910				350
2/87	27-49/50	TOTAL	COMPOSITE	4-12 IN			1300				
2/87	27-59/60	TOTAL	COMPOSITE	4-12 IN			2000				1700
2/87	27-59/60	TOTAL	COMPOSITE	4-12 IN			2100				1400
2/87	27-65/66	TOTAL	COMPOSITE	4-12 IN			210				
2/87	27-69/70	TOTAL	COMPOSITE	4-12 IN			780				780
2/87	27-71/72	TOTAL	COMPOSITE	4-12 IN			1100				930
2/87	27-73/74	TOTAL	COMPOSITE	4-12 IN		210	9900	230			1800
2/87	27-75/8	TOTAL	COMPOSITE	4-12 IN			570				

*** 10 ADDITIONAL COMPOSITE SAMPLES CONTAINING LOW LEVELS OMITTED

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: KENNEDY/JINKS/CHILTON, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
9/86	MW-3A	TOTAL	GRAB	SURFACE								
9/86	MW-4A	TOTAL	GRAB	SURFACE					0.59		150	
9/86	MW-4A	DI WATER EXTRACT	GRAB	SURFACE					<.01		.02	
9/86	SS-1	TOTAL	GRAB	SURFACE								
9/86	SS-2	TOTAL	GRAB	SURFACE								
9/86	SS-3	TOTAL	GRAB	SURFACE					51	11	9400	
9/86	SS-3	DI WATER EXTRACT	GRAB	SURFACE				< 3	0.14		0.04	
9/86	SS-5	TOTAL	GRAB	SURFACE							93,000	
9/86	WALL	TOTAL	GRAB	BLDG WALL							340,000	
9/86	SLOPE	TOTAL	GRAB	SURFACE							410,000	
9/86	TP-1	TOTAL	GRAB	5 FT								
9/86	TP-5	TOTAL	GRAB	4.5 FT					<0.5		230	
9/86	TP-6	TOTAL	GRAB	3-4 FT								
9/86	TP-9	TOTAL	GRAB	5.5 FT					<0.4		140	
9/86	TP-13	TOTAL	GRAB	---								
9/86	TP-16	TOTAL	GRAB	1.5 FT								
9/86	TP-20	TOTAL	GRAB	0-3 FT					<0.4		90	
9/86	TP-20	TOTAL	GRAB	7-9 FT								
9/86	TP-30	TOTAL	GRAB	2-3 FT								
9/86	TP-30	TOTAL	GRAB	3.5-4.5FT								

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: KENNEDY/JINKS/CHILTON, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
9/86	MW-3A	TOTAL	GRAB	SURFACE			140				
9/86	MW-4A	TOTAL	GRAB	SURFACE			440				430
9/86	MW-4A	DI WATER EXTRACT	GRAB	SURFACE			<0.5				0.1
9/86	SS-1	TOTAL	GRAB	SURFACE			140,000				
9/86	SS-2	TOTAL	GRAB	SURFACE			94,000				
9/86	SS-3	TOTAL	GRAB	SURFACE		250	120,000				140,000
9/86	SS-3	DI WATER EXTRACT	GRAB	SURFACE			1.6				64
9/86	SS-5	TOTAL	GRAB	SURFACE			35,000				
9/86	WALL	TOTAL	GRAB	BLDG WALL			150,000				
9/86	SLOPE	TOTAL	GRAB	SURFACE			64,000				
9/86	TP-1	TOTAL	GRAB	5 FT			810				
9/86	TP-5	TOTAL	GRAB	4.5 FT			89				150
9/86	TP-6	TOTAL	GRAB	3-4 FT			350				2200
9/86	TP-9	TOTAL	GRAB	5.5 FT			110				73
9/86	TP-13	TOTAL	GRAB	---			52				
9/86	TP-16	TOTAL	GRAB	1.5 FT			8.8				
9/86	TP-20	TOTAL	GRAB	0-3 FT			240				42
9/86	TP-20	TOTAL	GRAB	7-9 FT			3.1				
9/86	TP-30	TOTAL	GRAB	2-3 FT			2.4				
9/86	TP-30	TOTAL	GRAB	3.5-4.5FT			2				

TABLE A1 (CONT.) SOILS
SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE
CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
8/86	LOT 4	TOTAL	GRAB	SURFACE				140		19		
8/86	LOT 4	EP TOX	GRAB	SURFACE				0.3				
8/86	LOT 6,7,8	TOTAL	COMPOSITE	SURFACE				120	2.2	20		
8/86	PAINT SHOP	EP TOX	GRAB	SURFACE				1.1		0.1		
8/86	OIL TANK	EP TOX	GRAB	SURFACE				0.6				
8/86	BLACK SMITH	EP TOX	GRAB	SURFACE				0.6				
8/86	COKE STORAGE	TOTAL	GRAB	SURFACE		20		250	0.8	10		
8/86	COKE STORAGE	EP TOX	GRAB	SURFACE				0.3				
2/87	27-9	TOTAL	GRAB	4-12 IN		31					6100	
2/87	27-10	TOTAL	GRAB	4-12 IN		23					2700	
2/87	27-11	TOTAL	GRAB	4-12 IN		41					730	
2/87	27-31	TOTAL	GRAB	4-12 IN		8.2				460	320	
2/87	27-32	TOTAL	GRAB	4-12 IN		3.5				90	54	
2/87	27-33	TOTAL	GRAB	4-12 IN		2.8				120	150	
2/87	27-34	TOTAL	GRAB	4-12 IN		2.8				130	98	
2/87	27-37	TOTAL	GRAB	4-12 IN		5.8				150	95	
2/87	27-38	TOTAL	GRAB	4-12 IN		7				390	290	

** 3 SAMPLES NOT INCLUDED - LOW VALUES
** E P TOX. mg/l

TABLE A1 (CONT.) SOILS

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn	Hg
8/86	LOT 4	TOTAL	GRAB	SURFACE			300					0.3
8/86	LOT 4	EP TOX	GRAB	SURFACE			0.1					<0.005
8/86	LOT 6,7,8	TOTAL	COMPOSITE	SURFACE			180					0.4
8/86	PAINT	EP TOX	GRAB	SURFACE			0.3					
	SHOP											
8/86	OIL TANK	EP TOX	GRAB	SURFACE								
8/86	BLACK	EP TOX	GRAB	SURFACE								
	SMITH											
8/86	COKE	TOTAL	GRAB	SURFACE			390					0.1
	STORAGE						<0.1					
8/86	COKE	EP TOX	GRAB	SURFACE			1700					
	STORAGE						1900					
2/87	27-9	TOTAL	GRAB	4-12 IN			1700	29			320	
2/87	27-10	TOTAL	GRAB	4-12 IN			1900	90			720	
2/87	27-11	TOTAL	GRAB	4-12 IN			1700	180			810	12
2/87	27-31	TOTAL	GRAB	4-12 IN		740	50				340	
2/87	27-32	TOTAL	GRAB	4-12 IN			300				86	
2/87	27-33	TOTAL	GRAB	4-12 IN			85				63	
2/87	27-34	TOTAL	GRAB	4-12 IN			34				33	
2/87	27-37	TOTAL	GRAB	4-12 IN							62	
2/87	27-38	TOTAL	GRAB	4-12 IN		280	87				130	

** 3 SAMPLES NOT INCLUDED - LOW VALUES

** E P TOX. mg/l

SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN MG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: APPLIED GEOTECHNOLOGY, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
4/87	AG TP7	EP TOX	COMPOSITE	0-3 FT							0.05	

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
4/87	AG TP7	EP TOX	COMPOSITE	0-3 FT			0.12				0.1

APPLIED GEOTECHNOLOGY, INC. DAY EIGHT TEST PITS: SOIL FROM THE UPPER 3 FEET OF THE PIT WAS COMPOSITED AND SENT TO THE LABORATORY FOR ANALYSIS. EP EXTRACTS OF THE SAMPLES WERE OBTAINED AND ANALYZED FOR EP TOXICITY METALS, PCBS, AND POLYCYCLIC AROMATIC HYDROCARBONS (PAHs). ALL RESULTS WERE WELL BELOW DANGEROUS WASTE LEVELS.

WHERE REPORTED: KENNEDY/JENKS/CHILTON, 88

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Al	As	B	Ba	Cd	Cr	Cu	Fe
10/86	SD-1	TOTAL	GRAB									
10/86	SD-3	TOTAL	GRAB									
10/86	SD-4	TOTAL	GRAB									
10/86	SD-6	TOTAL	GRAB									
10/86	SD-7	TOTAL	GRAB									
10/86	SD-6	EP TOX	GRAB									

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	Mn	Ni	Pb	Sb	Sn	V	Zn
10/86	SD-1	TOTAL	GRAB				320				
10/86	SD-3	TOTAL	GRAB				530				
10/86	SD-4	TOTAL	GRAB				96				
10/86	SD-6	TOTAL	GRAB				1200				
10/86	SD-7	TOTAL	GRAB				310				
10/86	SD-6	EP TOX	GRAB				<0.5				

**STORM DRAIN SEDIMENT

TABLE A2 SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN ug/kg UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	METHYLENE CHLORIDE	TRICHLORO FLUOROMETH	ACETONE	1,2 DIPHENA HYDRAZINE	CHLOROFORM
10/11/82	CBS-09	TOTAL	GRAB	28 FT	62*	3.6			
10/11/82	CBS-09	TOTAL	GRAB	33 FT	28*	6.0			
10/11/82	CBS-10	TOTAL	GRAB	23 FT	34*	4.6			
10/11/82	CBS-10	TOTAL	GRAB	38 FT	44*	4.2			
10/14/82	CBS-11	TOTAL	GRAB	18 FT	9.9*	4.7			
10/14/82	CBS-11	TOTAL	GRAB	38 FT	31*	2.7			
10/13/82	CBS-12	TOTAL	GRAB	13 FT	8.1*	6.0			
10/13/82	CBS-12	TOTAL	GRAB	28 FT	62*				
11/16/82	CBS-13	TOTAL	GRAB	48 FT	3.8*				
11/16/82	CBS-13	TOTAL	GRAB	78 FT	6.7*				
10/25/82	FIELD BLANK ANALYSES APPLICABLE TO SAMPLES CBS-01 - CBS-48							70	
10/25/82	FIELD BLANK ANALYSES APPLICABLE TO SAMPLES CBS-01 - CBS-48							130	10
11/09/82	FIELD BLANK ANALYSES APPLICABLE TO SAMPLES CBS-01 - CBS-48						37	570	20

WHERE REPORTED: EARTH CONSULTANTS AND BENLAB, 85

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	INDENO PYRENE	PYRENE	PHENOL	ACENAPH-THENE	OIL & GREASE
2/85	TP-24	EP TOX	GRAB	7-8 FT					0.64
2/85	TP-28	EP TOX	GRAB	0-0.5 FT					1.43
2/85	TP-28	EP TOX	GRAB	6-7 FT					0.29

** 16 SAMPLES ANALYZED FOR HALOGENATED HYDROCARBONS (HHs), PAHs, AND OIL AND GREASE - ALL HHs AND PAHs <0.01 & 1 MG/KG RESPECTIVELY

TABLE A2 (CONT.) SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	FLUOR-ANTHENE	NAPHTHA-LENE	BIS(2ETH) PHTHALATE	DINBUTYL PHTHALATE	B C ANTHR	B C PYRE	3.4BENZO FLUORANTH	BENZO(K) FLUORANTH
10/18/82	CBS-26	TOTAL	GRAB	SURFACE			29000					
10/18/82	CBS-27	TOTAL	GRAB	1 FT								
10/18/82	CBS-28	TOTAL	GRAB	SURFACE								
10/18/82	CBS-29	TOTAL	GRAB	1 FT		7600						
10/18/82	CBS-30	TOTAL	GRAB	SURFACE				520				
10/18/82	CBS-31	TOTAL	GRAB	1 FT								
10/18/82	CBS-32	TOTAL	GRAB	SURFACE								
10/18/82	CBS-33	TOTAL	GRAB	1 FT								
10/18/82	CBS-34	TOTAL	GRAB	SURFACE	2700				1300	1100	1200	1200
10/18/82	CBS-35	TOTAL	GRAB	1 FT	880				520	800K	800	800K
10/18/82	CBS-36	TOTAL	GRAB	SURFACE	560				640	2000	2100	1000
10/18/82	CBS-37	TOTAL	GRAB	1 FT	880				960	1800	1500	1500
10/18/82	CBS-38	TOTAL	GRAB	SURFACE	1000				1600	1800	1600	1600
10/18/82	CBS-39	TOTAL	GRAB	1 FT								
10/18/82	CBS-40	TOTAL	GRAB	SURFACE								
10/18/82	CBS-41	TOTAL	GRAB	1 FT	400K							
10/18/82	CBS-47	TOTAL	GRAB	SURFACE								
10/18/82	CBS-48	TOTAL	GRAB	1 FT	400K	400K						
10/11/82	CBS-01	TOTAL	GRAB	23 FT								
10/11/82	CBS-01	TOTAL	GRAB	28 FT								
10/13/82	CBS-02	TOTAL	GRAB	13 FT								
10/13/82	CBS-02	TOTAL	GRAB	28 FT								
10/09/82	CBS-03	TOTAL	GRAB	28 FT								
10/09/82	CBS-03	TOTAL	GRAB	38 FT								
10/11/82	CBS-04	TOTAL	GRAB	18 FT								
10/11/82	CBS-04	TOTAL	GRAB	38 FT								
10/11/82	CBS-05	TOTAL	GRAB	13 FT				400K				
10/11/82	CBS-05	TOTAL	GRAB	23 FT								
10/12/82	CBS-06	TOTAL	GRAB	13 FT								
10/12/82	CBS-06	TOTAL	GRAB	23 FT								
10/12/82	CBS-07	TOTAL	GRAB	18 FT								
10/12/82	CBS-07	TOTAL	GRAB	47 FT								
10/13/82	CBS-08	TOTAL	GRAB	13 FT								
10/13/82	CBS-08	TOTAL	GRAB	18 FT								

TABLE A2 (CONT.) SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	CHRYSENE	BENZO(GHI PERYLENE	PHENAN-THRENE	DIBENZO ANTHRACEN	INDENO PYRENE	PYRENE	2 METHYL-NAPTHALEN	1,2DICLOR ETHANE
10/18/82	CBS-26	TOTAL	GRAB	SURFACE	10000K		10000K					
10/18/82	CBS-27	TOTAL	GRAB	1 FT								
10/18/82	CBS-28	TOTAL	GRAB	SURFACE								
10/18/82	CBS-29	TOTAL	GRAB	1 FT							800K	
10/18/82	CBS-30	TOTAL	GRAB	SURFACE								
10/18/82	CBS-31	TOTAL	GRAB	1 FT								
10/18/82	CBS-32	TOTAL	GRAB	SURFACE								
10/18/82	CBS-33	TOTAL	GRAB	1 FT								
10/18/82	CBS-34	TOTAL	GRAB	SURFACE	3000	800K	1300		800K	2900		
10/18/82	CBS-35	TOTAL	GRAB	1 FT	560		800			1100		
10/18/82	CBS-36	TOTAL	GRAB	SURFACE	1000	1300	400K	1000	1100	880		
10/18/82	CBS-37	TOTAL	GRAB	1 FT	1200	1600	400K		1800	1100		
10/18/82	CBS-38	TOTAL	GRAB	SURFACE	1500	1200	400	1300	2100	1400		
10/18/82	CBS-39	TOTAL	GRAB	1 FT								
10/18/82	CBS-40	TOTAL	GRAB	SURFACE						400K		
10/18/82	CBS-41	TOTAL	GRAB	1 FT	400K		400K			400K		
10/18/82	CBS-47	TOTAL	GRAB	SURFACE								
10/18/82	CBS-48	TOTAL	GRAB	1 FT			400K			400K		
10/11/82	CBS-01	TOTAL	GRAB	23 FT								
10/11/82	CBS-01	TOTAL	GRAB	28 FT								
10/13/82	CBS-02	TOTAL	GRAB	13 FT								
10/13/82	CBS-02	TOTAL	GRAB	28 FT								
10/09/82	CBS-03	TOTAL	GRAB	28 FT								
10/09/82	CBS-03	TOTAL	GRAB	38 FT								
10/11/82	CBS-04	TOTAL	GRAB	18 FT								
10/11/82	CBS-04	TOTAL	GRAB	38 FT								
10/11/82	CBS-05	TOTAL	GRAB	13 FT								
10/11/82	CBS-05	TOTAL	GRAB	23 FT								
10/12/82	CBS-06	TOTAL	GRAB	13 FT								
10/12/82	CBS-06	TOTAL	GRAB	23 FT								
10/12/82	CBS-07	TOTAL	GRAB	18 FT								
10/12/82	CBS-07	TOTAL	GRAB	47 FT								
10/13/82	CBS-08	TOTAL	GRAB	13 FT								
10/13/82	CBS-08	TOTAL	GRAB	18 FT								

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SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED; BLACK & VEATCH, 83

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	METHYLENE CHLORIDE	TRCHLORFL METHANE	ACETONE	PCB-1248	PCB-1254	PHENOL	BENZOIC ACID	ACENAPH-THENE
10/18/82	CBS-26	TOTAL	GRAB	SURFACE	25*	10		57900			100000K	
10/18/82	CBS-27	TOTAL	GRAB	1 FT	4.8*	3.3			1444**			
10/18/82	CBS-28	TOTAL	GRAB	SURFACE	23*	5.6						
10/18/82	CBS-29	TOTAL	GRAB	1 FT	2.0*	2.1						
10/18/82	CBS-30	TOTAL	GRAB	SURFACE	5	2.5					11000	
10/18/82	CBS-31	TOTAL	GRAB	1 FT	6.5	2.5K				400K		
10/18/82	CBS-32	TOTAL	GRAB	SURFACE	7.0							
10/18/82	CBS-33	TOTAL	GRAB	1 FT								
10/18/82	CBS-34	TOTAL	GRAB	SURFACE								
10/18/82	CBS-35	TOTAL	GRAB	1 FT	8.0*	4						
10/18/82	CBS-36	TOTAL	GRAB	SURFACE	53	4						
10/18/82	CBS-37	TOTAL	GRAB	1 FT	19		33					
10/18/82	CBS-38	TOTAL	GRAB	SURFACE	15							
10/18/82	CBS-39	TOTAL	GRAB	1 FT	27	14						
10/18/82	CBS-40	TOTAL	GRAB	SURFACE	14							
10/18/82	CBS-41	TOTAL	GRAB	1 FT	14							
10/18/82	CBS-47	TOTAL	GRAB	SURFACE	3.6	2.7				3600		
10/18/82	CBS-48	TOTAL	GRAB	1 FT	3.7	4.3				1900		
10/11/82	CBS-01	TOTAL	GRAB	23 FT	24							
10/11/82	CBS-01	TOTAL	GRAB	28 FT	10							
10/13/82	CBS-02	TOTAL	GRAB	13 FT	5							
10/13/82	CBS-02	TOTAL	GRAB	28 FT	31							
10/09/82	CBS-03	TOTAL	GRAB	28 FT	9.4							
10/09/82	CBS-03	TOTAL	GRAB	38 FT	11							
10/11/82	CBS-04	TOTAL	GRAB	18 FT	6.2							
10/11/82	CBS-04	TOTAL	GRAB	38 FT	32							
10/11/82	CBS-05	TOTAL	GRAB	13 FT	24							
10/11/82	CBS-05	TOTAL	GRAB	23 FT	29	2.5K						
10/12/82	CBS-06	TOTAL	GRAB	13 FT	74							
10/12/82	CBS-06	TOTAL	GRAB	23 FT	22							
10/12/82	CBS-07	TOTAL	GRAB	18 FT	8.7							
10/12/82	CBS-07	TOTAL	GRAB	47 FT	7.7							
10/13/82	CBS-08	TOTAL	GRAB	13 FT								
10/13/82	CBS-08	TOTAL	GRAB	18 FT	110							

* = DETECTED IN LABORATORY BLANK; ** = NOT CONFIRMED BY GC/MS ANALYSIS; ND = NOT DETECTED; K = DETECTED BELOW > 1/2 SPECIFIED LIMIT; NA = NOT ANALYZED

TABLE A2 (CONT.) SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN ug/kg UNLESS OTHERWISE NOTED

WHERE REPORTED: PIERCE CO. HEALTH DEPT., 86

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	FLUORAN-THENE	NAPHTHA-LENE	DI-H-BUTY	B C PYRENE	CHRYSENE	BENZO (GHI)	PHENAN-THRENE	DIBENZO (GH)
2/86	SB-4	TOTAL	GRAB	2 FT	3	2.2	2.6	1.6	9.8		24	ND
2/86	SB-5	TOTAL	GRAB	0.5 FT	2.8	12			<1		30	ND
2/86	SC1	TOTAL	COMPOSITE		1.6	2.2			3.5		7.2	ND
2/86	SC2	TOTAL	COMPOSITE	SURFACE	0.078	0.1		0.086	0.078	0.094	0.15	0.031
2/86	S-1	TOTAL	GRAB	SURFACE	0.86	0.46			1.6	0.59	2.2	ND
2/86	S-2	TOTAL	GRAB	SURFACE	1.2	0.49		0.36	0.88		1.3	ND
2/86	S-3	TOTAL	GRAB	SURFACE	1.1	5.5		0.99	1.4	0.63	2.6	0.28
2/86	S-4	TOTAL	GRAB	SURFACE	0.79	1.0			11		1.5	ND
2/86	S-5	TOTAL	GRAB	SURFACE	1.3	ND			ND		0.73	ND
2/86	S-6	TOTAL	GRAB	SURFACE	1.8	0.35		0.7	0.99		1.9	ND

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	INDENO PYRENE	PYRENE	PHENOL	ACENAPH-THENE	OIL & GREASE	ETHYL-BENZENE	TOLUENE	TOTAL XYLENES	BENZO (a) ANTHRACEN
2/86	SB-4	TOTAL	GRAB	2 FT		12		2.2					2.6
2/86	SB-5	TOTAL	GRAB	0.5 FT		13		4.4					<1
2/86	SC1	TOTAL	COMPOSITE		ND	5.9		0.87					2.8
2/86	SC2	TOTAL	COMPOSITE	SURFACE	0.071	0.078		ND					0.078
2/86	S-1	TOTAL	GRAB	SURFACE	ND	3		0.3					0.83
2/86	S-2	TOTAL	GRAB	SURFACE	0.14	1.2		ND					0.41
2/86	S-3	TOTAL	GRAB	SURFACE	0.51	3.4		ND					0.48
2/86	S-4	TOTAL	GRAB	SURFACE	ND	1.2		ND					15
2/86	S-5	TOTAL	GRAB	SURFACE	ND	1.4		ND					0.33
2/86	S-6	TOTAL	GRAB	SURFACE	0.53	1.4		ND					0.54

TABLE A2 (CONT.) SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: PIERCE CO. HEALTH DEPT., 86

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	TOL PERCENT	FLUORENE	ANTHRECEN	ACENEPHTH	PAHs	BENZO (a) PYRENE	BENZO PERYLENE	BENZO (b) FLUORANTH
2/86	SB-4	TOTAL	GRAB	2 FT	34.6%	6.1	3.9		1.4%	1.6		2.2
2/86	SB-5	TOTAL	GRAB	0.5 FT	12.5%	6.9	7.1		1.4%			<1
2/86	SC1	TOTAL	COMPOSITE			1.3	1.4			ND	ND	0.39
2/86	SC2	TOTAL	COMPOSITE	SURFACE	3.3%	ND	ND			0.086	0.094	0.12
2/86	S-1	TOTAL	GRAB	SURFACE	3.9%	0.43	0.51			ND	0.59	ND
2/86	S-2	TOTAL	GRAB	SURFACE	3.63%	ND	0.15			0.36	ND	1.0
2/86	S-3	TOTAL	GRAB	SURFACE	15.7%	ND	ND			0.99	0.63	ND
2/86	S-4	TOTAL	GRAB	SURFACE	7.76%	ND	ND			ND	ND	ND
2/86	S-5	TOTAL	GRAB	SURFACE	9.27%	ND	0.16			ND	ND	ND
2/86	S-6	TOTAL	GRAB	SURFACE	5.01%	0.076	0.15	0.092		0.70	ND	1.5

ND - NOT DETECTED, USUALLY < 0.2 ug/g

WHERE REPORTED: KENNEDY/JINKS/CHILTON, 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	PHENOL	OIL & GREASE	ETHYL-BENZENE	TOLUENE	TOTAL XYLENES
9/86	MW-1F	TOTAL	GRAB	23 FT		610,000			
9/86	MW-2F	TOTAL	GRAB	23 FT		6,700,000	38	10	90
9/86	MW-2G	TOTAL	GRAB	28.5		32,000,000	800		5,900
9/86	MW-2H	TOTAL	GRAB	33.5		210,000	<500	<500	<500
9/86	SS-3	TOTAL	GRAB	SURFACE	150				

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SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	PAH	BENZENE	ETHYL BENZENE	TOTAL XYLENES	1,1,1 TRICHLORO	TOLUENE
8/86	OIL TANK	TOTAL	GRAB	SURFACE	5100					
8/86	BLACK	TOTAL	GRAB	SURFACE	4400					
	SMITH				560					
8/86	COKE	TOTAL	GRAB	SURFACE						
	STORAGE									
2/87	27-21	TOTAL	GRAB	4-12 IN		3	2	2		
2/87	27-31	TOTAL	GRAB	4-12 IN					5	
2/87	27-32	TOTAL	GRAB	4-12 IN					19	
2/87	27-32(DUP	TOTAL	GRAB	4-12 IN					9	
2/87	27-36	TOTAL	GRAB	4-12 IN		2	1	6		2
2/87	27-33	TOTAL	GRAB	4-12 IN					3	
2/87	27-34A	TOTAL	GRAB	4-12 IN					3	
2/87	27-36(DUP	TOTAL	GRAB	4-12 IN		2		13		1
2/87	27-3	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 5075			
2/87	27-9	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 4257			
2/87	27-10	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 5297			
2/87	27-11	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 10480			
2/87	27-31	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 36878			
2/87	27-32	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 36974			
2/87	27-33	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 4040			
2/87	27-34	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 13525			
2/87	27-36	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 2473			
2/87	27-36A	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 2244			
2/87	27-37	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 9316			
2/87	27-37	TOTAL	GRAB	4-12 IN			TOTAL BNAs = 2617			

**** 52 ADDITIONAL SAMPLES - NO DETECTABLE LEVELS

**** BNAs - TOTAL EXTRACTABLE ORGANICS

PAH - POLYNUCLEAR AROMATIC HYDROCARBONS

TABLE A2 (CONT.) SOILS

SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	PAH	BENZENE	ETHYL BENZENE	TOTAL XYLENES	1,1,1 TRICHLORO	TOLUENE
3/87	27-39/40	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	7300		
3/87	27-41/42	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	2187		
3/87	27-41/42	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	1610		
3/87	27-43/44	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	13766		
3/87	27-45/46	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	1834		
3/87	27-47/48	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	12836		
3/87	27-49/50	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	25930		
3/87	27-51/52	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	980		
3/87	27-53/54	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	2340		
3/87	27-55/56	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	988		
3/87	27-57/58	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	1240		
3/87	27-59/60	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	2765		
3/87	27-59/60	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	2517		
3/87	27-61/62	TOTAL	COMPOSITE	4-12 IN			TOTAL BNAs	1776		

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SUMMARY OF ORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

CONCENTRATIONS IN UG/KG UNLESS OTHERWISE NOTED

WHERE REPORTED: REMEDIAL TECHNOLOGIES, INC., 87

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH		
3/87	27-64/63	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	797
3/87	27-65/66	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	2632
3/87	27-67/68	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	1010
3/87	27-69/70	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	4680
3/87	27-71/72	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	5890
3/87	27-73/74	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	741
3/87	27-75/8	TOTAL	COMPOSITE	4-12 IN	TOTAL BNAs	1840

WHERE REPORTED: KENNEDY/JINKS/CHILTON, 88

SAMPLE DATE	SAMPLE ID NO.	TYPE OF ANALYSIS	TYPE OF SAMPLE	DEPTH	
10/86	GS-2	TOTAL	GRAB	1-1.5 FT	1,1,1 TRICHLOROETHANE = 550, TETRACHLROETHYLENE = 300, XYLENE = 5000
10/86	SD-3	TOTAL	GRAB		TOTAL PETROLEUM HYDROCARBONS (AS DIESEL) = 8500
10/86	SD-7	TOTAL	GRAB		TOTAL PETOLEUM HYDROCARBONS (AS KEROSENE) = 6100

TABLE A2 (CONT.) SOILS

SUMMARY OF PCBs AND ORGANICS DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN mg/kg UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID NO.	WHERE REPORTED	METHOD	TYPE SAMPLE	DEPTH FT.	TOTAL PCBs	TOTAL VOLATILES UNCHLORINATED	DICHLORO-BENZENE	LPAH	HPAH
9/26/89	DW-1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.18				
9/26/89	DW-2	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.89				
9/26/89	DW-3	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	.60				
9/26/89	DW-4	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.82				
9/26/89	DW-5	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.15				
9/26/89	DW-8	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.34				
9/26/89	DW-10	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	3.66				
9/26/89	DW-13	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	1.01				
9/26/89	DW-15	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	1.68				
9/26/89	DW-17	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	2.9				
9/26/89	DW-18	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.66				
9/26/89	DW-19	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	2.85				
9/26/89	DW-20	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	3.5				
9/26/89	DW-21	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	1.16				
9/26/89	DW-22	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	14.0				
9/26/89	DW-24	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	0.15				
9/26/89	DW-25	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	ND				
9/26/89	DW-26	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-0.5 FT	ND				
9/28/89	DW-19-S1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-.5 FT	1.89	ND	ND	92.6	825.0
9/28/89	DW-19-S2*	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	1.5-2 FT	620.0				
9/28/89	DW-22-S1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-.5 FT	4.04	1.38	1.02	ND	ND
9/28/89	DW-22-S2	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	1.5-2 FT	4.0				
9/28/89	HC-05-S1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-.5 FT	12.0		ND	ND	ND
9/28/89	HC-06-S1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-.5 FT	0.77				
9/28/89	HC-07-S1	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	0-.5 FT	114.0		ND	ND	ND
9/28/89	HC-07-S2	TACOMA PUBLIC UTILITIES, 89	TOTAL	GRAB	1.5-2 FT	47.00				

* ALSO TESTED FOR TOTAL LEAD - 194 mg/kg

13 ADDITIONAL SAMPLES TESTED BELOW DETECTION LIMIT FOR PCB

TABLE A3 GROUND WATER

SUMMARY OF ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

PARAMETERS

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	pH	SALINITY PARTS PER THOUSAND	CONDUCTIVITY MICROMHOS	COLOR	TURBIDITY	NH3	SULFIDE	CL (ppm)	NITRATE-N (ppm)	B
		DETECTION LIMITS						100	50	1.0	0.01	100
10/20/82	CBS-01	BLACK & VEATCH, 83	6.3	0.2	190	CLEAR	VERY TURBID	370	70	12	0.03	ND
11/10/82	CBS-01	BLACK & VEATCH, 83	6.2	0.3	195	BROWN	VERY TURBID	190	ND	1.0	1.4	530
10/20/82	CBS-02	BLACK & VEATCH, 83	6.3	0.2	195	CLEAR	SLIGHTLY TURBID	370	ND	4.0	0.08	ND
11/10/82	CBS-02	BLACK & VEATCH, 83	6.3	0.3	168	CLEAR	SLIGHTLY TURBID	440	ND	3.0	2.3	1900
10/20/82	CBS-03	BLACK & VEATCH, 83	6.6	0.2	150	CLEAR	SLIGHTLY TURBID	ND	ND	2.0	0.02	ND
11/10/82	CBS-03	BLACK & VEATCH, 83	6.3	0.3	167	CLEAR	CLEAR	ND	ND	ND	0.98	960
10/20/82	CBS-04	BLACK & VEATCH, 83	7.7	0.5	310	BROWN	TURBID	200	130	1.0	0.04	1000
11/11/82	CBS-04	BLACK & VEATCH, 83	6.8	0.5	272	CLEAR	SLIGHTLY TURBID	ND	ND	3.0	1.7	2000
10/19/82	CBS-05	BLACK & VEATCH, 83	8.2	0.2	140	CLEAR	----	ND	ND	7.0	0.03	ND
11/04/82	CBS-05	BLACK & VEATCH, 83	6.3	0.2	87	LT BROWN	TURBID	ND	ND	ND	0.44	640
10/21/82	CBS-06	BLACK & VEATCH, 83	6.6	1.0	1100	GRAY/BROWN	TURBID	1760	ND	350	ND	110
11/11/82	CBS-06	BLACK & VEATCH, 83	6.4	1.0	1100	CLEAR	SLIGHTLY TURBID	1200	ND	430	0.69	800
10/19/82	CBS-07	BLACK & VEATCH, 83	9.4	0.5	220	BROWN	SLIGHTLY TURBID	240	ND	6.0	0.06	ND
11/04/82	CBS-07	BLACK & VEATCH, 83	7.4	0.4	210	LT BROWN	TURBID	ND		7.0	2.8	620
10/21/82	CBS-08	BLACK & VEATCH, 83	6.6	1.0	1100	DARK GRAY	VERY SILTY	930		30	2.2	1200
11/11/82	CBS-08	BLACK & VEATCH, 83	6.4	1.0	1090	DARK GRAY	----	530		35	0.4	1600
10/21/82	CBS-09	BLACK & VEATCH, 83	6.1	0.3	290	GRAY	SLIGHTLY TURBID	1030		4.0	19	130
11/11/82	CBS-09	BLACK & VEATCH, 83	6.0	0.5	292	CLEAR	SLIGHTLY TURBID	620		3.0	0.32	1000
10/19/82	CBS-10	BLACK & VEATCH, 83	7.8	0.5	270	CLEAR	----	ND		10	0.05	ND
	CBS-10	BLACK & VEATCH, 83	--	--	--	CLEAR	----	ND		12	5.3	640
10/19/82	CBS-11	BLACK & VEATCH, 83	6.6	0.5	330	CLEAR	----	ND		6.0	0.04	ND
11/04/82	CBS-11	BLACK & VEATCH, 83	6.5	0.4	319	LT BROWN	SLIGHTLY TURBID	ND		ND	2.0	1080
10/21/82	CBS-12	BLACK & VEATCH, 83	6.3	0.3	165	BROWN	SLIGHTLY TURBID	140		4.0	0.64	ND
11/10/82	CBS-12	BLACK & VEATCH, 83	6.4	0.3	125	CLEAR	SLIGHTLY TURBID	ND		1.0	2.8	430

TABLE A3 (CONT.) GROUND WATER

SUMMARY OF ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	Fe	Mn	Zn	Cu	Cd	Hg	Cn	Ba	As
		DETECTION LIMITS	50	15	10	50	1	0.2	10	100	10
10/20/82	CBS-01	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND		
11/10/82	CBS-01	BLACK & VEATCH, 83	45	42	250	ND	ND	ND	ND		
10/20/82	CBS-02	BLACK & VEATCH, 83	ND	ND	12	ND	ND	ND	110		
11/10/82	CBS-02	BLACK & VEATCH, 83	88	24	180	43	ND	ND	ND		
10/20/82	CBS-03	BLACK & VEATCH, 83	ND	ND	15	ND	6.5	ND	ND		
11/10/82	CBS-03	BLACK & VEATCH, 83	ND	16	150	ND	ND	ND	ND		
10/20/82	CBS-04	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND		
11/11/82	CBS-04	BLACK & VEATCH, 83	57	ND	160	ND	ND	ND	ND		
10/19/82	CBS-05	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND		
11/04/82	CBS-05	BLACK & VEATCH, 83	81	ND	650	ND	ND	ND	ND		
10/21/82	CBS-06	BLACK & VEATCH, 83	290	260	52	ND	ND	ND	ND		
11/11/82	CBS-06	BLACK & VEATCH, 83	1100	330	150	45	ND	0.62	ND		
10/19/82	CBS-07	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND		
11/04/82	CBS-07	BLACK & VEATCH, 83	ND	ND	380	ND	ND	0.73	ND	ND	ND
10/21/82	CBS-08	BLACK & VEATCH, 83	13600	1400	20	ND	ND	ND	17	ND	18
11/11/82	CBS-08	BLACK & VEATCH, 83	17500	1300	100	ND	ND	ND	ND	490	ND
10/21/82	CBS-09	BLACK & VEATCH, 83	15000	1100	45	ND	1.6	ND	ND	ND	ND
11/11/82	CBS-09	BLACK & VEATCH, 83	17500	1200	160	ND	ND	ND	ND	200	ND
10/19/82	CBS-10	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND	ND	ND
	CBS-10	BLACK & VEATCH, 83	ND	ND	350	ND	ND	ND	ND	ND	ND
10/19/82	CBS-11	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	ND	ND	ND	ND
11/04/82	CBS-11	BLACK & VEATCH, 83	40	16	300	46	ND	0.94	ND	ND	ND
10/21/82	CBS-12	BLACK & VEATCH, 83	ND	ND	32	ND	ND	ND	17	ND	ND
11/10/82	CBS-12	BLACK & VEATCH, 83	44	13	100	ND	ND	ND	ND	ND	ND

TABLE A3 (CONT.) GROUND WATER

SUMMARY OF ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	METHYLENE CHLORIDE	TRICHLORO-FLUORMETHANE	ACETONE	NAPHTHALENE
		DETECTION LIMITS	1	1	1	2
10/20/82	CBS-01	BLACK & VEATCH, 83				
11/10/82	CBS-01	BLACK & VEATCH, 83				
10/20/82	CBS-02	BLACK & VEATCH, 83	21		89	
11/10/82	CBS-02	BLACK & VEATCH, 83		16		
10/20/82	CBS-03	BLACK & VEATCH, 83			18	
11/10/82	CBS-03	BLACK & VEATCH, 83				
10/20/82	CBS-04	BLACK & VEATCH, 83				
11/11/82	CBS-04	BLACK & VEATCH, 83				
10/19/82	CBS-05	BLACK & VEATCH, 83			35	
11/04/82	CBS-05	BLACK & VEATCH, 83			152	
10/21/82	CBS-06	BLACK & VEATCH, 83				
11/11/82	CBS-06	BLACK & VEATCH, 83				
10/19/82	CBS-07	BLACK & VEATCH, 83				
11/04/82	CBS-07	BLACK & VEATCH, 83			430	
10/21/82	CBS-08	BLACK & VEATCH, 83				25
11/11/82	CBS-08	BLACK & VEATCH, 83				
10/21/82	CBS-09	BLACK & VEATCH, 83				
11/11/82	CBS-09	BLACK & VEATCH, 83				
10/19/82	CBS-10	BLACK & VEATCH, 83				
	CBS-10	BLACK & VEATCH, 83				
10/19/82	CBS-11	BLACK & VEATCH, 83				
11/04/82	CBS-11	BLACK & VEATCH, 83				
10/21/82	CBS-12	BLACK & VEATCH, 83				
11/10/82	CBS-12	BLACK & VEATCH, 83				

TABLE A3 (CONT.) GROUND WATER

SUMMARY OF ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	pH	SALINITY PARTS PER THOUSAND	CONDUCTIVITY MICROMHOS	COLOR	TURBIDITY	NH3	SULFIDE	CL (ppm)	NITRATE-N (ppm)	B
11/04/82	CBS-13	BLACK & VEATCH, 83	7.1	0.6	457	CLEAR	----					
11/16/82	CBS-13	BLACK & VEATCH, 83	11.2	1.0	1120	GRAY	SLIGHTLY TURBID	ND		200	0.12	810
11/30/82	CBS-13	BLACK & VEATCH, 83	10.7	0.3	431	CLEAR	SLIGHTLY TURBID	ND		160	ND	600
12/02/82	CBS-49	BLACK & VEATCH, 83						250		11	ND	830
10/25/82	*CBS-44	BLACK & VEATCH, 83										700
10/25/82	*CBS-45	BLACK & VEATCH, 83										600
11/09/82	*CBS-46	BLACK & VEATCH, 83										450

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	Fe	Mn	Zn	Cu	Cd	Hg	Cn	Ba	As
11/04/82	CBS-13	BLACK & VEATCH, 83									
11/16/82	CBS-13	BLACK & VEATCH, 83	ND	ND	51	ND	ND	ND	ND	ND	ND
11/30/82	CBS-13	BLACK & VEATCH, 83	ND	ND	ND	ND	ND	1.2	ND	ND	ND
12/02/82	CBS-49	BLACK & VEATCH, 83	110	180	140						
10/25/82	*CBS-44	BLACK & VEATCH, 83			21						
10/25/82	*CBS-45	BLACK & VEATCH, 83			20						
11/09/82	*CBS-46	BLACK & VEATCH, 83			240						

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	METHYLENE CHLORIDE	TRICHLORO-FLUORMETHANE	ACETONE	NAPHTHALENE
11/04/82	CBS-13	BLACK & VEATCH, 83				
11/16/82	CBS-13	BLACK & VEATCH, 83				
11/30/82	CBS-13	BLACK & VEATCH, 83				
12/02/82	CBS-49	BLACK & VEATCH, 83	12			
10/25/82	*CBS-44	BLACK & VEATCH, 83				
10/25/82	*CBS-45	BLACK & VEATCH, 83				
11/09/82	*CBS-46	BLACK & VEATCH, 83			37	

SUMMARY OF ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID/LOCATION	WHERE REPORTED	Pb	Zn	Cu
9/86	MW-1	KENNEDY/JINKS/CHILTON, 87	20		0.02
9/86	MW-04	KENNEDY/JINKS/CHILTON, 87	10	0.02	
9/86	CBS-04	KENNEDY/JINKS/CHILTON, 87	20		
9/86	CBS-05	KENNEDY/JINKS/CHILTON, 87	20		
9/86	CBS-12	KENNEDY/JINKS/CHILTON, 87	30		
11/87	MW-5	KENNEDY/JINKS/CHILTON, 87	TRICHLOROFLUOROMETHANE = 200; 1,1,1 TRICHLOROETHENE = 34		
9/86	CBS-04	KENNEDY/JINKS/CHILTON, 87	pH = 7.39, Pb = 10		

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SUMMARY OF INORGANIC ANALYTICAL DATA AT THE SOUTH TACOMA FIELD SUPERFUND SITE

(CONCENTRATIONS IN ppb UNLESS OTHERWISE NOTED)

SAMPLE DATE	SAMPLE ID NO.	WHERE REPORTED	pH	Al	Fe	B	Mn	Zn	Pb	CN	SULFIDE
		DETECTION LIMITS	(UNITS)	200	50	100	15	10	5	5	50
10/22/82	CBS-14	BLACK & VEATCH, 83	6.1	460	470	320	28	100	29	17	210
10/22/82	CBS-15	BLACK & VEATCH, 83	6.2	260	270	370	27	100	14	10	
10/22/82	CBS-16	BLACK & VEATCH, 83	6.3		240	190	27	65	14	17	
10/22/82	CBS-17	BLACK & VEATCH, 83	6.2	230	270	180	24	77	17	17	
10/25/82	CBS-18	BLACK & VEATCH, 83	6.7		780	830	66	110	-		330
10/25/82	CBS-19	BLACK & VEATCH, 83	6.5		810	820	57	160			
10/25/82	CBS-20	BLACK & VEATCH, 83	6.8		780	830	66	85			130
10/25/82	CBS-21	BLACK & VEATCH, 83	6.2		880	890	350	280			130
10/25/82	CBS-22	BLACK & VEATCH, 83	8.2	280	470	1700	29	51		16	210
10/25/82	CBS-23	BLACK & VEATCH, 83	6.8			150		16			210
10/86	SD-2 *	KENNEDY/JINKS/CHILTON, 88							9000		
10/86	SD-5 *	KENNEDY/JINKS/CHILTON, 88							1600		

*STORM DRAIN WATER

SAMPLE DATE	SAMPLE ID NO.	WHERE REPORTED	SALINITY	CONDUCTIVITY	Cl	NH3	Ba	Cd	COLOR	TURBIDITY
		DETECTION LIMITS	MICROMHOS/CM	PRTS PER THOU	1000	100	100	1		
10/22/82	CBS-14	BLACK & VEATCH, 83	0.1	140					CLEAR	CLEAR
10/22/82	CBS-15	BLACK & VEATCH, 83	0.1	80					CLEAR	CLEAR
10/22/82	CBS-16	BLACK & VEATCH, 83	0.1	150					CLEAR	CLEAR
10/22/82	CBS-17	BLACK & VEATCH, 83	0.1	145					CLEAR	CLEAR
10/25/82	CBS-18	BLACK & VEATCH, 83	0.4	217					SL YELLOW	CLEAR
10/25/82	CBS-19	BLACK & VEATCH, 83	0.4	225					SL YELLOW	CLEAR
10/25/82	CBS-20	BLACK & VEATCH, 83	0.3	190					SL BROWN	CLEAR
10/25/82	CBS-21	BLACK & VEATCH, 83	0.5	800	2550	640			CLEAR	CLEAR
10/25/82	CBS-22	BLACK & VEATCH, 83	1.0	900			220		CLEAR	CLEAR
10/25/82	CBS-23	BLACK & VEATCH, 83	0.9	800				14	CLEAR	CLEAR
10/86	SD-2 *	KENNEDY/JINKS/CHILTON, 88								
10/86	SD-5 *	KENNEDY/JINKS/CHILTON, 88								

*STORM DRAIN WATER